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The Deterioration and Failure of Glassworks Refractories

By B. M. Pearson

Glassworks refractories may be roughly headed under the following categories—tank blocks, firebrick for the upper parts of tank furnaces, pot furnaces, pot arches, and the fireboxes of lehrs; glass pots, and silica bricks, used in the construction of the crowns of tank furnaces. The conditions of service will naturally vary from one class of refractory to another, and so the life of the different kinds of refractories will vary greatly.

Roughly speaking, failure of refractories is caused by the three principal agents: high temperature, chemical action, resulting in corrosion, mechanical stress. A refractory may be subjected to one or a combination of all these influences affecting the life. To combat undue and excessive failure, the great thing is to pick out the principal active agent, and then if possible to design a refractory with those particular properties which will enable it to withstand the effect of this agent, at the same time retaining those properties which will enable the refractory to successfully resist any other influences which would result in undermining its longevity.

It is quite easy to design a refractory to resist any one of the damaging agents, but it is an extremely difficult task to design a refractory which will resist a combination of these influences, such as is usually met with in glassworks practice. For instance, consider refractoriness. There are a number of extremely refractory substances, such as carbon, lime, pure alumina and dolomite, etc., but fireclay is the only possible medium for making tank blocks of. Again, there are a large number of substances which are not attacked at all by molten glass, but are not sufficiently resistant to high temperatures to be included amongst the refractories.

Let us consider, as a commencement, that class of refractories termed tank blocks. These blocks have to withstand temperatures up to 1,500 deg. C, so that they must be quite refractory at this heat, and must not commence to fail in refractoriness until a temperature is reached very considerably higher than this heat. They are at the same time exposed to the action of the molten glass at this temperature, and the problem resolves itself into endeavoring to enclose a molten silicate, at a temperature such that it is very active chemically, by another kind of silicate not dissimilar in composition. The blocks also have to carry the weight of the upper part of the furnace, and the crown of the tank, and in addition, to resist the thrust of the molten glass.

Refractoriness is a measure of the capacity of the block to withstand the action of high temperatures, and for the melting point of the particular refractory in question to be so elevated that it will not flux sufficiently to deform under its own weight.

The refractoriness of a fireclay will depend on a number of conditions. In some respects the chemical composition is quite important, but with a large number of clays, perplexing anomalies occur when it is attempted to correlate the chemical composition with the refractoriness, and so, on its own, certainly, the chemical composition of a fireclay is an unreliable guide of the refractoriness. Again, on the other hand, chemical composition is a great asset in the work of eliminating undesirable raw materials from the manufacture of refractories. A chemical analysis is very useful as an indication of the nature and extent of the harmful impurities present. Thus the presence of excess of alkali in the refractory lowers the refractoriness very considerably, also the lime and magnesia should not exceed a fairly low limit, and the iron oxide should be low.

The chemical composition of some typical glass tank blocks is given below, together with the refractoriness.

	Stourbridge	Huddersfield	Glenboig	
SiO_2	67.77	76.25	65.41	58.90
Al_2O_3	29.11	20.39	30.55	37.58
TiO_2			1.33	
Fe_2O_3	1.78	2.41	1.70	1.71
CaO	0.62	0.71	0.69	0.54
MgO			0.64	0.47
Na_2O ..... K_2O	0.46	0.20	0.65	0.36 0.84
Refractoriness .	3			

[1] *Tschrmak. Min. Pet. Mitt.* 1899. 18.56-57.
[2] *Journal Soc. Glass Technology*, Dec., 1926.

The highly refractory nature of fireclays is rather curious as, starting with alumina, which is quite highly refractory, and adding silica, we arrive at a composition which results in maximum fusibility, and which is almost the same as the composition of the majority of refractory fireclays. Pure alumina has a melting point of 2000 deg. C. When the molecular ratio is two of silica to one of alumina the melting point is down to 1770 deg. C. With the silica and alumina in the molecular ratio of four to one, the melting point is down to 1710 deg C. Of course, it must not be lost sight of that in such a laboratory test as the above, the silica and alumina are in intimate contact. On the other hand, in a commercial refractory, the silica and alumina, the former especially, usually exist in a more or less coarse physical form and the contact may be anything but intimate, which conditions will mitigate very considerably the interaction.

Resistance to Chemical Corrosion

The refractoriness of a tank block is of not nearly such a pressing question, as is the resistance to chemical corrosion. The refractory requirements, for instance, are not so very exacting, and it is not at all difficult to make a block which would be considered satisfactory from this aspect. But it is not saying too much to state that the life of a block is decided by how long it can hold up, before it is corroded and eaten away by the molten glass, to such a state of thinness that it is no longer strong enough to be able to resist the thrust of the molten glass in the tank.

The resistance of the block to this chemical corrosion of the glass will depend upon several factors, all more or less related. The physical condition of the block is one of the most important items. Thus the mineralogical condition, porosity, uniformity and fineness of texture, as also external factors such as the composition of the glass, and the working temperature of the furnace are all decisive features in deciding the life of the block in service. Equally as important is the chemical composition of the block.

Taking these factors in their order, and treating first with the physical factors: The uniformity and fineness of texture is a factor worthy of very serious consideration. Unfortunately, uniformity is a feature which is not always incorporated during the manufacture of the block. The grog, for instance should be of the same composition as the rest of the block. If different parts of a tank block are going to corrode and dissolve up in the glass at different rates, it means that those parts of the refractory which prove more resistant to the attack of the molten glass will be undermined by the less resistant portions of the block dissolving up. Ultimately, these projecting portions will drop off into the molten glass, and will result in the untimely disintegration of the block, and also prove objectionable by causing stones in the glass. The texture of the block should also be fine, which will lead to uniform corrosion. The porosity of the tank block should not be unduly high. The more porous the block is, the greater will be the surface area exposed to the attack of the molten glass. Correspondingly greater also will be the attack of the glass in the block, in direct proportion to the increase of surface area. Another factor of the denseness of a tank block is that the body should be free from objectionable fissures and cavities caused by the inclusion of air-bubbles in the clay during the manufacture of the block. Fissures are especially objectionable as they allow the glass to penetrate right inside the body of the block, where the attack can proceed with greater facility. These fissures may be produced by unhomogeniety of the clay in making the refractory; too liberal a use of grog; drying cracks induced by unsuitable drying conditions; or a badly blended mixture of clays; incorrect firing of the blocks in the kiln, or incorrect bringing up of the tank furnace in which the blocks were set up to working heat. With the exception of bringing the furnace up to working heat, all the previous causes are solely in the hands of the refractory manufacturer to remedy, if it is desired to deliver a better block. The last mentioned fault is in the hands of the glass manufacturer, and apropos this point it is astonishing how little care is exercised over such an important task as bringing up a tank furnace to working heat, and how many tank blocks are prematurely ruined, at such an early stage. It cannot be too strongly stressed that months can be taken off the life of a tank block by hurrying over this stage.

Mineralogical Composition of Blocks

The mineralogical composition of the tank block is extremely important. The clay used for making the refractory will consist principally of kaolinite having the chemical formula $Al_2O_3\ 2SiO_2\ 2H_2O$. There will also be present a certain amount of iron oxide and titanium oxide, and generally a small percentage of the alkaline oxides. These latter oxides are present in the clay combined as the fluxing feldspars and micas. It will be realized that there may be a quite considerable amount of these compounds present in the clay body. The alkaline oxides represent roughly one-seventeenth of the total composition of the compounds. So that if there were two per cent of alkaline oxide in the clay, actually there would be present about fourteen per cent of the feldspar. Now the kaolinite on heating loses its combined water at about 500 deg. C. On further heating at about 600 deg. C. the dehydrated kaolinite is decomposed into free alumina and silica. Again on heating to still higher temperatures, the free alumina and silica commence to combine together again at about 900 deg. C., to form a compound termed sillimanite and which has the following chemical formula, $Al_2\ O_3\ Si\ O_2$. At 1,700 deg. C, a further compound termed mullite is formed having the chemical formula, $2\ Al_2\ O_3\ 3\ SiO_2$. The formation of sillimanite is however very slow and even at 1,300 deg. C., only extremely small amounts are formed, and it is only when temperatures of about 1,400-1,500 deg. C. are approached that appreciable amounts of this compound are formed in the body of the block. It would be, in the ordinary course of events, hopeless to expect the presence of sillimanite in the structure of the block itself. Tank blocks are rarely fired to 1,400 deg. C., and even if the refractories manufacturer takes the blocks up to this temperature in his kiln, he never lets them soak for say twenty-four hours or longer. The presence of fluxes however, in the block, mentioned above, appears to exert a real beneficial influence on hastening the formation of sillimanite, and enabling the formation of this compound to take place at a lower temperature than would otherwise be the case if a pure clay, free from fluxes were employed. For this reason, and since com-

mercial fireclays are never innocent of fluxes, the formation of this compound can fairly readily be induced in the tank block. The glass manufacturer, however, cannot always rely upon his blocks having had the correct firing treatment in the kiln. For this reason, when a tank furnace is brought up to working heat, it should be kept at the maximum temperature for a full three days, in order to cause the formation of that condition of the block which will prove the most resistant to the attack of the molten glass. This will be the true state of affairs because a network of sillimanite will be formed through the body of the block.

It is the usual practice to glaze a tank block when bringing the furnace up to working heat. This is very beneficial in effecting the formation of a block extremely resistant to chemical corrosion. The glazing is effected by spreading cullet over the floor of the furnace, and when the heating is sufficiently advanced for the cullet to be more or less fluxed, it is raked up by furnace tools, over the face of the tank blocks. This layer of cullet acts as a protective mantle against the action of the raw batch when it is filled into the furnace. Raw molten alkali is a very corrosive medium. It is quite deficient in silica and alumina, and so will readily dissolve these components from the block. As these two compounds, of course, constitute by far the major portion of the block composition, the consequence is that the block is rapidly eaten away. So rapid is the corrosion that the outer layers of the block in which there might have been some sillimanite formed are soon removed, and the attack is transferred to the center of the refractory which is still in practically an untransformed condition, and least able to resist the attack. The corrosion then proceeds with alarming rapidity until the block is eaten through and fails. Again, the alkali will easily penetrate into the fissures and irregularities of the block face, and attack the walls of the cavities. In this connection, some rather interesting work has been done by Professor Cobb of Leeds University. He has found that interaction between oxides can take place at temperatures far below the melting points of the individual oxides. Thus he has detected a reaction between silica and sodium oxide at as low a temperature as 500 deg. C. This is very important as regards effecting tank block behavior. When the furnace is brought up, oxides will penetrate into the fissures, and will combine with the substance of the block at quite low temperatures, forming definite chemical compounds. After a time the temperature of the furnace will be raised sufficiently high for these compounds formed internally to flux. The physical constants of such compounds will be quite different from those of the block itself, as the chemical composition will be so different from the original composition of the refractory. In particular the co-efficients of expansion and contraction will vary very considerably, and so the flux formed by the interaction of the alkali with the fireclay will peel off, and separate from the block. By this means, large pieces of the block will be separated, and will fall into the glass. To avoid this, the block should not come into contact with any destructive agent such as a glaze forming glass, or raw batch, until it has been exposed to the working heat of the furnace for at least three days. In this way a very resistant structure will be developed within the block, and the attack of the glass or alkali will not be nearly so severe on the block. Then when these corroding agents come into contact with it, they will not exercise nearly such a destructive influence, and the life of the block will be very much longer.

The glazing of the tank block also acts in another direction beneficially. When the glass is applied to it the former will dissolve the alumina chiefly, and also the silica. The effect of the addition of the alumina is to make the slag very viscous, so that a protective slag is interposed between the block and the active metal. Further, the alumina dissolved into the glaze from the block, combines with the silica after a time, when the glaze is saturated, forming sillimanite, which crystallizes out. In this way a protective layer of sillimanite is built up on the face of the block, which effectually protects the refractory from a considerable amount of corrosion. The effectiveness of this protection is marred however, as the crystals float off into the metal, and lose their protective value by dissolving up. It is therefore much better to form the sillimanite right throughout the texture of the block by judicious heat treatment in the bringing up of the furnace, rather than by merely relying upon the glaze to protect the block from too rapid corrosion of the glass.

Crystallization Conditions

The conditions under which corundum and sillimanite crystallize out from melts of the alumina silicates of the bases lime, potash and soda have been worked out by Moro Tewicz.[1] He shows that while a saturated alumina-silicate of soda such as $Na_2\ Al_2\ Si_6O_{16}$, albite feldspar, can dissolve a large excess of alumina at high temperatures, the similar lime silicate dissolves only a small quantity and a pure potash silicate does not dissolve any excess alumina. On cooling, the alumina separates out in various forms.

A melt in which the molecular ratio of the bases (CaO K_2O, Na_2O) is to the alumina as 1:1 is said to be saturated with alumina. If more aluminum is present, the melt is super-saturated, and the excess is deposited, either as corundum, sillimanite, cordierite, or spinel. The last two only occur when the magnesia exceeds 0.5 per cent. The normal alumina, that is the quantity which does not exceed the saturation limit, together with a certain amount of silica, is in all cases needed to meet the prior demand of the alkaline basis for the formation of feldspar and feldspathoid molecules, which although they do not crystallize out, are always present as glass. The following represent the types of feldspathoid molecules formed:

$Na_2O\ Al_2O_3\ 6\ SiO_2$ Albite.
$Na_2O\ Al_2O_3\ 6\ SiO_2$ Soda Leucite.
$Na_2O\ Al_2O_3\ 6\ SiO_2$ Nephelite.

Writing the general formula for an alumino-silicate as $1\ R\ O.\ M.Al._2\ O_3\ n\ SiO_2$, where R is ($Ca$, K_2 NA_2), n is 2-13, and m is greater than unity, the following rules are found to apply.

When iron and magnesia are absent, or present only in small quantities, and n is less than 6, corundum is formed. Where the magnesia exceeds 0.5 per cent, and n is less than 6, spinel or spinel and corundum are formed. Finally, when magnesia is absent, and n is greater than 6, sillimanite or sillimanite and corundum are formed.

If the ratio of silica is less than 1:1:6, free silica will not crystallize as quartz, cristobalite, or tridymite. If the

alumina content is greater than the ratio, say 1:(1+a):6, then the excess of alumina may crystallize as corundum. If there also be an excess of silica, so that the ratio is 1:(1+a):(6+b) then the excess of alumina—a—and the excess of silica—b—may crystallize out as tridymite or cristobalite (or both), and sillimanite or again as sillimanite and corundum, or as sillimanite, according as a is less than, greater than, or equal to b. Corundum and silica cannot crystallize from the same melt. If there is an excess of both, sillimanite will make its appearance.

Corrosion Chief Cause of Failure

The chief agent resulting in the failure of tank blocks is undoubtedly chemical corrosion. It is interesting to examine a section of refractory after it has been in use in the furnace. There will be noticed three distinct sections of different material. First is the original and unaltered portion of the block. Next to this will be noticed a narrow layer of a white porcelain-like looking material—½ mm. in thickness. Forming the outside layer, which lies next to the molten glass is a dark brown slaggish looking layer, rather thicker than the porcelain layer, and a few mm. in thickness. If the white porcelain layer is examined under a microscope it will be seen to consist of a network of needle-like crystals set in a glassy matrix, and it is in this zone that the crystallization of the sillimanite actually takes place and this is the layer extremely resistant to the glass attack, and which serves to protect the refractory. Analysis of this white porcelain layer and also of the brown outside slaggy layer will show results somewhat similar to the following:

	1	2	3	4	5	
Silica (SiO_2)	53.30	42.26	41.70	54.92	52.22	(1) Mixed of sillimanite and fused layer.
Alumina (Al_2O_3)....	35.73	40.65	40.60	31.01	33.54	(2) Glassy slag.
Iron oxide (Fe_2O_3)..	3.50	5.60	5.31	2.23	2.44	(3) Glassy slag.
Lime (CaO)	0.60	0.49	1.35	0.79	1.42	(4) Crown drip aluminous brick.
Sodium oxide (Na_2O)	5.70	9.82	10.04	9.22	10.07	(5) Crown drip aluminous brick.
Titania (TiO_2)	1.17	1.16	0.90	0.96	0.66	

It will be seen that there is a quite high percentage of alkali present—the source of this is of course the alkali content of the glass.

The mechanism of the chemical attack of a tank block is fairly well known, being an interesting chemical study.

When two bodies such as a tank block and molten glass, between which interaction can occur, are placed in contact, a definite reaction will take place, resulting in the formation of certain well defined compounds. The reaction need not however proceed to completion, but on the other hand the extent to which it can proceed may be based upon the external conditions, influencing the course of the reaction. Thus, to consider a tank block and molten glass in contact: The net result of the action proceeding to completion would be the formation of a compound having the average composition of the refractory and the glass. Examination of the above analyses however, in comparison with tank block and glass analyses, shows that this is not the case. It has been stated above that the extent to which the reaction proceeds will depend upon external conditions. Now the external conditions governing the corrosion of the refractory by the glass will be the furnace temperature, the nature of the block itself, and the chemical composition of the glass being

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FREDERICK CARDER and His Work

One who harbors the belief, or even a suspicion that the American glass industry is merely and entirely a monstrous mass production, money-making institution with no interest whatever in developing art and beauty in its products, is certain to quickly change his preconceived notions as soon as he visits the studio of Frederick Carder, art director of the Steuben Division of Corning Glass Works, at Corning, New York, and views the work of this distinguished artist. Here may be seen a remarkable collection of glass objects, designed and executed by the artist himself, which if better known would quickly dissipate what remains of the formerly widespread idea that for the very best in artistic glass, one must obtain the foreign productions. The few designs here illustrated give but a meagre idea of the ability and versatility shown by Mr. Carder in producing many beautiful specimens of both purely decorative and utilitarian ware.

Only recently, this year, his accomplishments have received additional recognition in the award to him by the Architectural League of New York of the Friedsam Gold Medal, given to the one who has done the most for Art in Industry.

Mr. Carder was born and educated in England. He received his early training in his father's pottery, and having seen the copy of the famous Portland vase, executed in glass by the late John Northland, became intensely interested in glass and made a connection as designer in one of the leading glass industries in England.

Seeing clearly the need for chemical and artistic investigation, he began research experiments which have been continuous for the past thirty-five years. To this end he attended classes in chemistry, physics, electricity and metallurgy, obtaining honors in these subjects.

His art education also was followed with success, and he was awarded gold, silver and bronze medals both in design and sculpture as well as a travelling scholarship. Later on he became Art Master of the Wordsley School of Art.

At the request of Thomas Turner, then Director of Technical Education for South Staffordshire, he started a class in glass manufacture, one of the first in Europe, where the broad principles of chemistry as applied to glass making were taught together with the artistic side.

In 1902 he visited, and made a report on the glass industry of Austria and Germany for the County Council of South Staffordshire.

In 1903, he came on a visit to the United States and decided to stay, and with T. G. Hawkes he started the Steuben Glass Works at Corning, to produce artistic glassware.

It has been his constant aim to improve and uphold the craftsmanship of the glass industry.

Mr. Carder in 1925, was appointed delegate on the Hoover Commission to study and report on the Paris Exhibition of that year.

He is a member of a number of artistic and scientific societies in this country and abroad. His interest in educational matters is indicated by his membership on the Board of Education in Corning, the town of his adoption.

Examples of Glassware Designed and Executed by Frederick C. Carder

1. Sculptured Vase in Crystal.
2. Cut Glass Jars—Modern Style.
3. Table Lamp in Smoke Crystal and Amber.
4. Table Lamp in Two Tone Glass; Figures in Bronze.
5. Mr. Carder in his Studio.
6. Engraved Decanters and Jars in Marina Glass.
7. Centre piece in Crystal Amber.
8. Centre, Millefiori Plate, Candlesticks in Cairngorm Glass. Cut Wine Glasses, Bristol Yellow and Black.
9. Rock Crystal Goblet.

For information on Mr. Carder's work in glass, see the opposite page.

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founded. The nature of the block as influencing its corrosion by the glass has already been dealt with in some detail above, considering the physical aspect of the question. The chemical composition of the block, also, however, plays a quite definite part in determining the extent of the corrosion. Thus it is known that an English ball clay, which is a fairly pure clay, will dissolve in molten glass more readily than will say a siliceous clay of the Stourbridge type.

In connection with the theory of glasses of different densities being formed by the solution of the clay in the metal, the work of Hyslop[2] is somewhat illuminating. He has studied the results obtained from different textures of refractories, and has come to the following conclusions by the employment of an indirect method of study:

Data given show that the disintegration in a solvent of a composite material, such as wax loaded with burnt clay particles, depends on two factors, these being:

(a) The density of the solute rich layer, relative to the solvent.

(b) The size of the particles.

If a light upward-flowing layer is formed, the material with large particles is more easily broken up than that containing small particles. The reverse holds if a dense, downward flowing layer is formed, the finer the particles, the more rapid being the corrosion.

Laboratory experiments on clay rods immersed in chosen glasses confirm the above statements in respect to the corrosion of clay by glass. In a lead glass, the clay with the larger grog was more corroded than that with the finer, but in a soda-lime glass the finer material was the more attacked. Consistent with a safety in other directions the evidence indicates that a refractory meant to withstand corrosion by a lead glass should contain as large a fraction of fine grog as possible, whereas one for use with a soda-lime glass should contain the maximum proportion of large grog. It is also shown that where erosion is the principal factor in the break up of the refractory, the conditions demand different characteristics in the grog, in that the material must hold the maximum amount of fine particles.

The above work is very interesting, but of course, great caution must be exercised in interpreting the results of such experimental work into large scale practice.

Now let us consider the effect of temperature in effecting the chemical corrosion of the block. When the glass first comes into contact with the clay, we have two dissimilar chemical compounds in contact, which are capable of reacting upon each other. Thus, if we consider the normal glass composition we will see that it is saturated with silica, lime and soda, and deficient and quite unsaturated with alumina. On the other hand, inspection of the tank block analysis shows that it is saturated with respect to silica and alumina and quite unsaturated with respect to soda and lime. As a consequence, the following sequence of events will take place when the two come into contact: Alumina, and to a smaller extent, silica, will be dissolved from the block by the glass. After a time the glass will become saturated with alumina in the zone immediately adjacent to the block, and this, combining with the silica will crystallize out to form the white porcelain layer, consisting principally of sillimanite. Far more complex silicates are formed in the first instance as analysis of the slag shows. These will principally fall into the feldspar family of silicates, but such compounds as nepheline may probably also exist. It is the excess alumina which is dissolved over and above that required to form the more complex silicates, which is the sillimanite forming factor. When the slag layer becomes saturated with alumina, the solution of the block in the glass is materially slowed up. The slag glass and refractory will then be in equilibrium with each other. Any change in any of the factors governing equilibrium, will immediately change the state of affairs and cause a new equilibrium to be set up. The effect of the addition of the alumina to the normal glass composition will be to make a slag very viscous at the ordinary furnace working temperature. Consequently the circulation of the block-dissolving solution will be very sluggish as soon as the high alumina glaze is formed on the surface of the block. If nothing happens now to change any of the conditions, the glass will be able to corrode the block only very slowly. But consider what a change in temperature will do, such a change as would occur were the tank being pushed harder to obtain a larger output of glass. The viscosity of the slag will be less at the higher temperature, and as a consequence it will diffuse into the glass much more rapidly than it did at the lower temperature and in the more viscous condition. As a consequence, the solution of the alumina from the block will be so much the more rapid to make up for the slag lost by diffusion. As a consequence, the corrosion of the block will be so much the more rapid at the higher temperature.

The corrosion of a tank block from the chemical aspect will bring in some rather different considerations. The glass generally melted in tank furnaces is what is termed the soda-lime type, containing say 67-75 per cent of silica, 0.5—4 per cent of iron and alumina, 7-14 per cent of lime, and magnesia, and 11-19 per cent of sodium oxide. The glass will act on the block. Alumina will be dissolved, and will form the slag on the face of it. As this slag layer will consist of definite compounds, such as feldspars, in which the ratio of the alumina to the alkalies will be more or less fixed, the amount of alumina actually present in the slag will depend upon the alkali content of the glass. Thus the more soda there is in the glass, the greater will be the ratio of the sodium oxide to the alumina, in the product resulting from the attack of the glass on the block, when the slag attains equilibrium with both the block and the glass. In consequence of this, the slag will be distinctly less viscous at any definite furnace temperature than would be one resulting from the attack of a glass comparatively low in alkali. As a result, the slag formed by the soft glass will diffuse into the metal quite easily and, the attack of the more alkaline glass, will be of greater intensity, than will be the attack of a glass harder in working properties. The homogeniety of the glass too, is of prime importance in this matter Consider the condition of a badly mixed batch. There will be local areas consisting of practically pure soda, and others containing little else but sand. When charged into the furnace, the soda, fluxing as it does at quite a low temperature, will easily melt and will run away from the rest of the difficulty melted batch materials. Having no oxides in its immediate vicinity to com-

bine with, it will follow the path of the glass through the furnace, and will, if the furnace is being worked sufficiently slowly, gradually more or less mix up with the other metal, but by no means ideally. These batches of glass extremely high in soda are a distinct menace to the life of the tank block. Being saturated with soda, and deficient both in silica and alumina they dissolve away the protecting slag with great readiness and if the areas are large enough may corrode sufficiently, so as to transfer their attack aggressively to the block itself and on account of its great chemical activity, and very low viscosity, the soda will penetrate right into the heart of the block in quite a short time and absolutely honeycomb it. This is an extreme state of affairs, of course, but there is no doubt whatever that these conditions are a fruitful cause of tank block failure. It will be realized that it is not only important to keep a check on the composition of the glass; the homogeniety of the metal, which, traced to a logical conclusion, means efficiency of batch mixing is also just as important.

Glass Composition Important

Also, it is very important to keep the composition of the glass as constant as possible. Variations are quite harmful, because the equilibrium is at once upset by a change in composition, and a fresh set of conditions must be set up. Whilst this is taking place, the corrosion of the block is particularly severe. A change from a hard glass to a soft one containing more sodium oxide is distinctly very harmful, as in this case the slag on the block face will be dissolved away, exposing the refractory to the direct attack of the glass. A change from a soft to a hard glass might even prove beneficial in arresting, to a certain amount, some of the attack. Thus the harder metal would be decidedly somewhat more inert to solution of the protecting slag than would be the softer glass, and would certainly be more inert to reaction with a slag formed by the softer glass, than the softer metal itself would be. The point, however, is really debatable, and it would be as well if it were taken as quite axiomatic that the composition of the glass should be kept constant within very close limits.

As the glass is usually saturated in respect to silica, it will not evince a very great tendency to dissolve this oxide from the refractory. It will be noted that the silica contents of the glass, the slag and the block, are, roughly speaking, all more or less the same, so that obviously a very marked reaction, or a considerable increase of silica, cannot have taken place. This may be the probable reason why a material consisting of practically pure clay substance such as a Devonshire ball clay, is definitely more soluble in glass, and less suitable as a raw material for the manufacture of a tank block, than is one such as a Stourbridge block, containing a good deal more silica, and which could accurately be described as a siliceous block. It is of course, bad practice to add silica to a fireclay, as a refractory of undesirable physical properties results, and at the same time the refractoriness is a good deal impaired by this procedure.

(To be continued)

Second Hearing on Plate Glass Production Costs

By the Tariff Commission at Washington

The second public hearing ordered by the United States Tariff Commission on March 11, 1927, in continuation of the investigation of costs of production of cast polished plate glass in the United States and in Belgium, the principal competing country, opened in Washington on May 9, with Commissioners Marvin (chairman), Dennis (vice chairman), Costigan, Brossard and Dixon, and Secretary John F. Bethune present. Meetings were held on May 9, 10, 11, 12 and 13.

The purpose of the investigation is to assist the President in determining whether the existing rate of duty equalizes domestic and foreign costs of production or what change in rate, upward or downward within the limit of 50 per cent, is necessary to accomplish such equalization.

A second preliminary statement of information containing additional cost data collected by the Commission in the course of this investigation had been prepared and was issued on March 25, 1927.

Various interests were represented at the hearing as follows: John R. Rafter, appearing for Belgian Plate Glass Manufacturers, members of the Belgian Union; Frank P. Wilson, appearing for Association of Imported Plate Glass Consumers and Sligh Furniture Company; J. Vaurie, appearing for Saint Gobain Company; L. DeGorter, appearing as agent for the Union Commerciale des Glaceries Belge; Royal T. McKenna and Alex Koplin, appearing for National Plate Glass Company, American Plate Glass Company, Edward Ford Plate Glass Company and Standard Plate Glass Company; P. J. McCumber, appearing for Pittsburgh Plate Glass Company, and George C. Davis, appearing for National Council of American Importers and Traders.

Previous to the taking of testimony, the Secretary called attention to an error that appeared in the preliminary statement of information issued on March 25, in Table 26 on page 42, where the costs of material and batch for each of the years was given per 1,000 pounds rather than per short ton, as should have been the case.

Mr. Rafter requested that the information secured by the Commission with respect to the cost of production and other data relating to plate glass produced by the so-called continuous process be summarized and published in the same manner and to the same extent as the data relating to cost of production and other facts with respect to plate glass produced by the older or discontinuous process have been summarized and published in the Commission's preliminary statement.

The Chairman pointed out that all the details which the Commission thought proper, under the restrictions by which it is compelled to conduct its investigation, was given in the statement, which embodied all of the information which would not divulge confidential or trade secrets of individual concerns.

He pointed out that the weighted average unit cost for 1924 would be slightly increased if the calculated costs for the continuous process were included in the average, and the unit costs for 1925 would be slightly decreased by the inclusion of the new process costs. In either case the change upward or downward would not be far from one cent per square foot. There are only two companies operating the new process although there are three plants. It has been the regular practice not to issue detailed cost of production of two companies because of the limitations of the statute in the publication of trade secrets.

At the close of the hearing on Friday, May 13, the Tariff Commission set Monday, June 13, as the day for exchange of briefs prepared by counsel for the opposing parties. The Commission then allowed until Monday, June 27, for those who wished to file replies to briefs. It is unlikely that the final decision of the Commission on making changes in the glass tariffs will be announced before next Fall.

Because of the extreme length of the official report of the proceedings (approximately 200,000 words), it is impossible in the space available to give more than a condensed suggestion of the witnesses' testimony. Long arguments and discussions by counsel over details, especially those of lesser importance, have been omitted.

The first witness called was Abraham Solomon, president of L. Solomon & Son, of New York, the largest importer of plate glass.

A. Solomon

THE CHAIRMAN asked regarding the method employed by manufacturers of Belgian plate glass in selling their product in this country; Mr. Solomon stated that they have agents at New York and San Francisco who represented the actual manufacturers. Orders are transmitted through the agents to the home office in Brussels or Paris. Belgian plate glass is sold through the Union Commerciale des Glaceries Belge which is composed of six Belgian manufacturers with one general executive and sales offices in Brussels.

In response to questions by Frank P. Wilson, Mr. Solomon stated that in 1926 approximately 20 per cent of plate glass imported by his concern at the Port of New York remained in warehouses or was consumed in the New York market, the balance being shipped to other markets, particularly the Detroit territory and practically all of the sales transactions were consummated in the head office in New York.

Asked whether or not selling costs should be included in the cost production, Mr. Solomon replied that they should be included in the same way that transportation is or should be included.

Asked about domestic plate glass marketing, Mr. Solomon stated that the methods of the various companies differed greatly, and gave examples.

An argument as to the definition of plate glass followed.

A magazine article on plate glass by J. W. Cruikshank was offered in evidence but at the final session was withdrawn.

Mr. Solomon offered in evidence the *Monthly Labor Review*, Vol. 24, No. 4, dated April, 1927,* and quoted from it as follows:

"The total labor cost of cast rough plate glass by the continuous process is 25.1 per cent less than by the discontinuous process, and the total labor cost of making polished plate glass is on the average 43.3 per cent less than by the discontinuous process."

This was objected to by Mr. McKenna who stated that it was obvious that the witness could not stand cross-examination on it. After some argument it was accepted.

Mr. Wilson then referred to the book "Today and Tomorrow" by Henry Ford, a manufacturer of plate glass, which contains a discussion of the production of plate glass by the continuous and pot processes.

The admission of this book was also objected to by Mr. McKenna who claimed that the witness was not qualified as an authority on costs.

Mr. Solomon was asked to state his opinion as to whether the continuous process of producing polished plate glass is in an experimental stage in this country.

Mr. Solomon said: "No, I think that there has been enough plate glass made in the United States by the continuous method to take it out of the class of experiment."

MR. WILSON: "How have your selling prices in the United States for imported plate glass compared with prices established by domestic manufacturers from time to time?"

MR. SOLOMON: "They have been, as a rule, slightly higher than the domestic price list, and on the small glass, the two-foot-eight, they are about 100 per cent higher."

COMMISSIONER BROSSARD: "May I ask whether the wholesale consumer of glass pays a higher price for the foreign glass than for the domestic glass?"

MR. SOLOMON: "The prices are about the same, with the exception of the small glass, in the one- to two-foot-eight bracket, which cannot be imported, except at a price almost 100% higher."

Asked by Mr. Wilson what in his opinion is the need for a lower duty on plate glass, Mr. Solomon replied:

"In my explanation of prices a minute ago, it is indicated clearly that a reduction is absolutely essential on small glass in order to be able to import it at all. The price of glass in the one- or two-foot-eight bracket being 18 or 19 cents a square foot, it cannot possibly be imported when the duty, freight and other expenses, amount to that. The selling prices at the present time in this country as formulated by the domestic manufacturers, are so low that by the time you get through paying your duty, freight and other expenses, the manufacturer on the other side would be getting considerably less than his cost, according to the statistics indicated in this report of the Commission, and naturally they are not keen and do not accept any orders for the small glass."

MR. WILSON: "Would the domestic market be injured by a lower rate of duty, in your opinion?"

MR. SOLOMON: "A lower rate of duty on small glass would just perhaps give us importers an opportunity of getting some of the desired sizes."

MR. WILSON: "What in your opinion should be the present rate of duty on imported plate glass, taking into consideration the cost of production of foreign and domestic plate glass and the selling prices in the United States?"

MR. SOLOMON: "Well, I think there ought to be a reduction of about 50 per cent on all products."

Mr. Wilson questioned Mr. Solomon as to the position the Pittsburgh Plate Glass Company held in the industry of the United States and the latter stated that eliminating from the calculation plate glass manufactured and plate glass factories owned by automobile interests, his conclusion would be that the Pittsburgh Plate Glass Company naturally manufactured from 65 to 75 per cent of all the other plate glass outside of that mentioned. He also gave the opinion that an increase of duty would mean an increase in selling prices.

The Continuous Process

MR. WILSON: "You have observed, Mr. Solomon, that the cost of production of plate glass made by the continuous method, is not included in the cost of production of plate glass, in the second preliminary statement of information."

MR. SOLOMON: "With the exception of that reference on page 27, and even from that reference, as guarded as it appears, we could still deduce an indicated saving of about 22 per cent for the continuous cost of production over the discontinuous."

MR. WILSON: "What is the detail there which allows you to figure a percentage of saving or a lower cost of production than the discontinuous method?"

MR. SOLOMON: "Assuming that the difference would be but one per cent per square foot for the year 1925, as given in the preliminary statement of the Commission, we find that the production, according to the figures stated in this book of information for the year 1925, was 117,000,000 square feet, and one cent on that would be $1,170,000. There also appears a table in the book which indicates that the production for the old method of glass was 104,000,000 square feet, therefore making the production for the continuous method of glass, 13,000,000 square feet. Now, if a saving of $1,170,000 can be accomplished by the production of 13,000,000 square feet, you have a saving of 9 cents per square foot, or about 22 per cent."

* See THE GLASS INDUSTRY, May, 1927.

CHAIRMAN MARVIN: "Well, assuming that if in the year 1925 the American factories were producing the maximum production, 100 per cent—I will state 100 per cent without any implication that that is the percentage of production for that year—and assuming that for 1925 the production in Belgium was 65 per cent of capacity, would a cost comparison based upon cost of plants running for a year's period at 65 per cent of capacity, with the cost of plants running, as you say, at maximum capacity for that period, represent a cost comparison on the basis of normal production?"

MR. SOLOMON: "I think that the figures of cost of production should be taken as to its actual production, regardless of percentage. I do not maintain that the American factories were producing 100 per cent each year, of capacity, because there is always a certain amount of loss in production, due to natural factors entering into the business, such as replacements of parts, natural wearing down of machinery, which has to be replaced, or whatever it might be."

CHAIRMAN MARVIN: "Well, if in the period covered by the investigation the production in Belgium one year dropped to 65 per cent, and other years it was as high as 85 or 90 per cent, do you think that a fair cost comparison for the purpose of the statute could be made on a basis solely of a year of lowest production in the competing foreign country?"

MR. SOLOMON: "No, I think the only fair comparison would be the actual production."

The annual statement for the Pittsburgh Plate Glass Company for 1926 was offered in evidence and after considerable argumentation was admitted.

MR. WILSON: "Mr. Solomon, what period should be used, in your judgment, in ascertaining the comparative costs of production in the United States and foreign countries, and why?"

MR. SOLOMON: "I believe that the latest figures obtainable should be the basis of calculations for future legislation. I think if it was possible to obtain the full figures of 1926 at the present time, that that would be even better than the figures of 1925, but in any case, the only figures in the book of information, this second preliminary statement, which I think should be used at all should be the figures for 1925."

Mr. Wilson asked what is the principal open market in the United States in which plate glass is sold in wholesale quantities. Mr. Solomon replied that the Detroit district or the mid-western territory from Chicago to Detroit, down to Indianapolis is the principal market.

Asked if anyone in the United States could buy directly from Belgium without taking into consideration the Belgian sales agents in the United States, Mr. Solomon replied that they could not.

Production Estimates

Mr. Solomon offered a calculation based on the 10th annual report of the Tariff Commission, as follows:

"Fully 80 per cent of the world's production at the present time (1925) is reported to be made by this method, referring to the discontinuous method. The table on page 9 of the second preliminary report for the year 1926 gives the European production as 106,000,000 square feet, and the American production for the same year as quoted on page 15, as 129,000,000 square feet, therefore making the world production for 1926, 235,000,000 square feet. Taking 80 per cent for the old or discontinuous method of making plate glass, that would make 188,000,000 square feet for the entire world, and 20 per cent under the new method, or the continuous method, or 47,000,000 square feet. Since there is no continuous method glass made in any other part of the world with the exception of one plant in England, a small production of perhaps three or four million square feet, I submit that the calculation here, even if we were to deduct 7,000,000 square feet, would still leave a production for 1926 of 40,000,000 square feet under the continuous method, at a much lower price than the discontinuous method, which indicates an increase of 27,000,000 square feet over 1925, according to the information contained in this second preliminary report. My object in outlining these figures is to indicate the constantly increasing production of the new method glass at a much lower cost."

"An average landing charge of one-half cent per square foot has been used for calculating delivered costs of imported glass. Is this a representative average for all ports of importation in the United States?" Mr. Solomon said that it should be higher and gave information concerning handling and loading at the docks, lighterage charges, trucking and other costs. A landing charge of 1½ cents per square foot would be more nearly correct.

On cross-examination Mr. Solomon was asked what charge is made at New York for handling glass from ship-side to truck and replied that it was $4.00 to $5.00 a case of 550 square feet, the weight being about 2,300 pounds. He referred to glass up to 120 united inches.

MR. MCKENNA: "Do I correctly understand you to say that in your opinion this so-called continuous process is revolutionizing the plate glass process at the present time?" Mr. Solomon: "Yes."

MR. MCKENNA: "Did you read in the statement of the Commission that there was only a variation of a cent one way or another?" MR. SOLOMON: "Yes." MR. MCKENNA: "What impression on your mind did that make, bearing in mind, that that statement was made after a complete analysis had been conducted of every large plate glass manufacturer in the United States and abroad."

MR. SOLOMON: "In the first place, the year 1925 and the year 1924, the years referred to here, were early years of the industry, and since then there have been further improvements in the industry and a much larger production, as I showed this morning, and the production has increased 300 per cent in one year, from 13,000,000 square feet in 1925 to over 40,000,000 square feet in 1926."

Asked by Mr. McKenna whether he had ever heard it said that the so-called continuous process glass could not be used in high grade cars, Mr. Solomon said that if it is only a glazing quality, which is an inferior quality, it represents 90 per cent, or perhaps 85 per cent of the total use of plate glass in all countries and for the average purposes, that more than 90 per cent used in the automobile industry is of the glazing quality, and the continuous process glass is absolutely equal to that quality.

The Belgian Union

MR. MCKENNA: "Is this so-called Union that sells Belgian glass to you what we would call a trust here in the United States?"

MR. SOLOMON: "You have a splendid explanation of the workings in this second preliminary statement."

MR. MCKENNA: "Does this Union control production?" MR. SOLOMON: "No, it does not, according to the statement."

MR. MCKENNA: "Does it control prices?" MR. SOLOMON: "No, I don't think it does. They do not control prices in the United States, if that is what you refer to."

MR. MCCUMBER: "What kind of glass is that which you purchase in Germany?" MR. SOLOMON: "We import a small quantity of cylinder glass, ground and polished. It comes under a different paragraph. The price and cost is entirely different."

Questioned by Mr. McCumber as to its use for automobile purposes, Mr. Solomon replied: "Not directly in the automobile, but it is used in a new product which has been manufactured in the last two or three years called laminated glass, this so-called bullet-proof glass. It consists of two pieces of glass glued or fastened together with a piece of celluloid or some other such material in between. And that laminated glass, of course, is made for different purposes in various thicknesses. Some people use a half-inch glass, some use a quarter inch, but there is a great deal of one-tenth and one-eighth inch glass that is used for that purpose. It has been used by the Pennsylvania Railroad for car windows for the last 25 years."

MR. MCCUMBER: "What do you know about the process of Pilkington Brothers of England?" MR. SOLOMON: "I know this that the Ford Company received perhaps a million feet of glass from Pilkington last year, and it paid the duty under the polished plate glass tariff, I believe."

MR. MCCUMBER: "Has the importation of plate glass increased during the past three years as rapidly as the increase in volume of plate glass manufactured in the United States?" MR. SOLOMON: "I have not made the computation. I cannot tell you off hand. In 1923 the relation of imports to total United States production was 29 per cent, in 1924 18 per cent, in 1925 13½ per cent, and in 1926, 18 per cent again. However, I think that comparison should be made on the total United States consumption rather than on production, and, of course, the ratio would be considerably smaller."

Suggests 50 Per Cent Reduction in Import Tax

MR. MCCUMBER: "You find there should be a reduction of 50 per cent of the duties on plate glass. You do not think it would hurt the manufacturers in the United States to make that reduction?" MR. SOLOMON: "I do not think so. It would

enable the importers to get the sizes they require and it would benefit the mirror manufacturers, furniture manufacturers and other consumers."

MR. MCCUMBER: "I do not see how it can benefit one without injuring the other."

MR. MCCUMBER: "This table shows the average cost of producing plate glass in the United States to be 44.20 cents per square foot. The average for the Belgian product to be 23.645 per square foot. The difference in favor of the foreign country is 20.559 notwithstanding the fact, if I understand you, that the costs in Belgium are 23 cents plus and in the United States 44 cents plus per square foot. Notwithstanding the fact that the law requires the President to put a duty to equalize the difference in the cost not exceeding 50 per cent you think there should be a reduction of 50 per cent?" MR. SOLOMON: "I still think so."

MR. MCCUMBER: "Are you basing your claim that there should be a reduction of 50 per cent solely upon the small sized glass?" MR. SOLOMON: "No, not solely."

MR. MCCUMBER: "You compute that it costs more to put down Belgian glass in Detroit than to produce the glass in Pittsburgh and put it down at Detroit." MR. SOLOMON: "That is right, about 2 or 3 cents a foot more."

MR. MCCUMBER: "Would that justify a reduction of 50 per cent?"

MR. MCKENNA: "What cash discount is allowed by the Union?" MR. SOLOMON: "2½ and 1 per cent."

MR. MCKENNA: "Do you know what the American cash discounts are, ten days? MR. SOLOMON: "One per cent."

Mr. Solomon explained that there is a discount of 2½ per cent in advance and that a breakage allowance is made of 2½ per cent for plate glass up to 15 feet and 3½ cents on plates over 15 feet. The American manufacturer makes no allowance for breakage. The foreign allowance is made whether the glass is broken or not. According to Mr. Solomon breakage is sometimes very excessive.

MR. KOPLIN: "Taking your figures for 1925, the difference between the average production cost in the United States and the average sales value is 8.26. In other words the spread or profit in the United States was 8.26."

MR. KOPLIN: "If we had a reduction of 50 per cent in that, and the American manufacturers had to meet the price of the foreign manufacturer who was able, on account of the decrease in duties, to put his product in this country just 7½ or 8 cents per square foot cheaper on account of the production, that would practically wipe out the entire spread between the production and the sales cost, would it not?"

Mr. Solomon: "If the factories in this country want to set the selling price, which gives them no profit, it is their own lookout. They are fixing the selling prices. They have made three reductions here in the past six months, which were absolutely, in my opinion, unwarranted, and if they choose to reduce their prices it is their own lookout, because the foreign manufacturers are not cutting their prices."

MR. KOPLIN: "Mr. Solomon, you do not think that a decrease of duty of 50 per cent will hurt the American manufacturers at all?" MR. SOLOMON: "I don't think so."

MR. KOPLIN: "Why not?" MR. SOLOMON: "Because the amount of glass that will be imported will not exceed the amount that is actually required here, and because the effect would only be to enable us to get certain sizes of glass which we cannot get at the present time."

MR. KOPLIN: "What would be the benefit to the American industry to bring in glass to sell in competition with American glass, [small sizes] which is already selling at less than the cost of production?" MR. SOLOMON: "Well, when the 1922 tariff went into effect the Ways and Means Committee were taking evidence in 1921. The selling price, if I remember correctly, in the one- to two-foot-eight bracket at that time was about 30 cents a square foot. Today for the same commodity it is 18 cents a square foot."

MR. KOPLIN: "What does that argue?" MR. SOLOMON: "It argues that the ad valorem rate has increased from 40 per cent to 100 per cent, in that period."

MR. MCKENNA: "You stated that the allowance made by the Belgian Union for packing was the same as that now being allowed by the American manufacturers?" MR. SOLOMON: "It is not an allowance, it is a charge. It is $5.00 a case up to 120 united inches, over 120 united inches up to 50 square feet, $6.00 a case; over 50 square feet up to 120 square feet, $8.00 a case and over 120 square feet, $12.00 a case."

MR. SOLOMON: "There has recently, in the last year, been created a demand for the use of plate glass for building purposes which ordinarily uses window glass, that is in the small sizes. We have inquiries for that sort of thing all the time. I might compliment the Pittsburgh Plate Glass Company and tell them that I believe they were the cause for this demand. Now we have those inquiries all the time, and we cannot supply them because these are small sizes such as used in cottage windows. You could not possibly import those at less than 100 per cent higher price than they can be obtained for here."

CHAIRMAN MARVIN: "The manufacturer necessarily has to recover the cost of production in some form. If he sells a part of the product, that has to bear the entire cost. If he sells all of the product, that is the large sizes and the small sizes, the costs can be distributed, to some extent, between the different sizes, and if the sale of small sizes is cut out entirely from the domestic manufacturer, there would have to be some increase in returns from the other sizes to take the place of loss of return from the small sizes not sold, would there not?"

MR. RAFTER: "Did you observe in the Commission's preliminary statement of information that in the cost figures which show that reduction of 9 cents per square foot there have apparently been included costs of experimentation?" MR. SOLOMON: "In a general way, yes."

CHAIRMAN MARVIN: "If in developing the so-called new continuous process it became necessary, perhaps more than once during the year, to discard certain machinery, that had been installed for that process, and have more improved machinery, do you or do you not think it proper to include in the cost of producing glass by that process during that year the cost of articles used in the process that were discarded and replaced by machinery of the kind designed to do better work or to do the work at a lower cost?"

MR. SOLOMON: "Yes, I think that should be taken into consideration, but of course, there is always the question whether or not these experimenting costs should not be allocated in some fashion. If a man makes an improvement in his office or house, I do not think he charges the entire improvement to the one year or the one month. I think the method has always been to make certain deductions over a period of time."

Charles B. Sligh

Following Mr. Solomon, Charles B. Sligh of the Sligh Furniture Company, Grand Rapids, Mich., was sworn as a witness.

Questioned as to the kind of glass purchased by his concern, Mr. Sligh stated that for several years they had used nothing but first or silvering quality glass imported from France, Belgium or Czecho-slovakia. He gave as a reason for not using domestic glass that the Pittsburgh Plate Glass Company had refused to sell him on the ground of his activities in the tariff discussion of 1922 and stated that he had a letter from a representative of the company at Grand Rapids showing that their action was intended as a punitive measure. Mr. Sligh stated that at the time of this occurrence he had an unfilled order with the Pittsburgh Plate Glass Company and testified that "they wrote us a letter that on account of my activity they did not care to continue the order and that I had made misrepresentations." Inasmuch as they could buy all the glass they wanted by importing it, Mr. Sligh said, they dropped the matter and have not bought anything from them since. The letter was signed by the company's local representative in Grand Rapids.

MR. MCKENNA: "The others [domestic manufacturers] seemed to be in a friendly attitude towards you?" MR. SLIGH: "They did."

MR. MCKENNA: "Do you suppose that the attitude of the Pittsburgh Plate Glass Company was influenced in any way by the litigation you had with the Stott Hecht Company, involving a breach of contract?" MR. SLIGH: "Well, I cannot say. I think that litigation was later."

VICE-CHAIRMAN DENNIS: "This purchaser has not a free market for the purchase of his supplies in this country, where his competitors have, and he must have recourse to imported plate glass. A change of duty upward, of course, would increase the cost of his raw material, whereas the man who purchased from the Pittsburgh Plate Glass Company or any other company in this country perhaps would not be affected so injuriously."

Answering a question, Mr. Sligh stated that comparatively few of the furniture manufacturers in the United States buy their supplies of glass abroad.

CHAIRMAN MARVIN: "Do you think that your inability at that time to accept the small sizes in connection with the shipment of the larger sizes had anything to do with the company declining to fill the order?" MR. SLIGH: "Well, for the reason that they did fill a part of our order and then cancelled the balance of it after my testimony—you will have to ask that question from them."

MR. WILSON: "You import glass of small size?" MR. SLIGH: "Largely, yes, sir."

MR. MCKENNA: "How about the breakage of this glass? Do you find an important amount of it broken or an inconsequential amount?" MR. SLIGH: "It don't amount to much."

MR. WILSON: "The breakage in small sizes is not as large in percentage as the breakage in the large sizes." MR. SLIGH: "No. They don't amount to anything."

MR. RAFTER: "Now with reference to the testimony regarding the through freight rate, did I understand you to say that those shipments were via Canadian port?" MR. SLIGH: "We ship all our glass, with the exception of one shipment, in care of Canadian Pacific Steamship Line. They deliver it to us f. o. b. Antwerp. They are delivering to us in Grand Rapids in bond. The Canadian port and railroad from Montreal."

MR. WILSON: "Did you have any trouble with that shipment?" MR. SLIGH: "As soon as it arrived in New York some commission agent grabbed on to it, although it was consigned in bond to Grand Rapids, but it was turned over to some commission agent, and he sent us a bill for several hundred dollars for clearing, etc., which we refused to pay, and we had correspondence which lasted two or three months, and ultimately we had to apply to Washington and get an order for the release of that glass to be shipped through in bond to Grand Rapids in accordance with the bill of lading. It was a great annoyance to us and waste of time, and ever since then we have shipped by the Canadian Pacific."

MR. MCKENNA: "So that during 1920 you had already established your contacts and glass had started its journey to the United States and you had left the American producer, and then when there came a period of great shortage in 1922 you asked for glass from the producers from whom you had not been purchasing, isn't that correct?" MR. SLIGH: "I think that is quite true."

MR. MCKENNA: "Could you, as a business man, reasonably expect to get glass from them when it was impossible to furnish glass to their own customers?" MR. SLIGH: "Well, that correspondence speaks for itself in regard to that."

This case was discussed at length and a telegraphic copy of the letter referred to by Mr. Sligh was offered and received in evidence.

Bastian Van Ry

The next witness was Bastian Van Ry, representing the Grand Rapids Store Equipment Corporation, of Grand Rapids, Mich.

MR. WILSON: "Do you use polished plate glass as a raw material in your product?" MR. VAN RY: "I imagine our total consumption for all of our factories [nine] is in the neighborhood of 650,000 feet per year. About 70 per cent glazing quality and the remaining 30 per cent mirror quality."

Mr. Van Ry testified that in 1923, due to the fact that the company's four sources of supply sold out to the automobile interests, they were "left flat" and that he made a trip to Europe in March, 1923 and arranged for a supply from there. The Grand Rapids factories now use practically entirely foreign glass, but the smaller branch factories buy through local jobbers. He also stated that taking into consideration the net price of domestic glass laid down at Grand Rapids domestic glass is a little under the price of foreign glass and that the foreign glass is a little better selected. He stated that they were buying abroad now because of the connections made in 1922 and have continued because the arrangement has been satisfactory.

Louis Roth

Louis Roth of New York, a certified public accountant, was then called as a witness on the importers' side.

After presenting evidence of his professional qualifications, Mr. Roth testified that he had figured the Belgian cost for plate glass delivered at important centers in the United States for the year 1925 and made tables of the same, drawing his data from the report of the Commission. He said that the figures in Table 36 in the Commission's statement at page 64 did not include selling expense. He figured the percentage of Belgium imports to the total United States consumption as 6.55 of the total production in the United States, plus the imports from foreign countries in 1925. He said that the difference in cost of production between the continuous and discontinuous methods, figured on a production by the former method of approximately 13,000,000 square feet, was a reduction of 9.04 cents per square foot.

Asked if experimentation costs should be figured in the cost of production for any one year, he answered negatively.

Mr. Roth testified: "The total production outside of that produced by the automobile interests in 1925 was 76,194,281 square feet, or 65 per cent. The total production by the Pittsburgh Plate Glass Company was 58,612,142 square feet or 50 per cent of the total. Consequently the total produced by the Pittsburgh Plate Glass Company as related to that of the total production outside of that produced by the automobile interests was 77 per cent of the total production in the United States."

Mr. Roth stated that he had schedules showing "the relative costs of production in the United States and in Belgium for the year 1925 under method No. 1, including the average freight from Belgium and the average freight from United States plants to their points of consumption, including also computed interest and other schedules showing the same average freight from Belgium and average freight from plants in the United States, excluding computed interest, and I have another series of schedules showing actual freight from United States plants and average freight from Belgium, both including and excluding computed interest."

These documents, showing the process of figuring delivery costs by different methods from different points, were placed in evidence.

MR. KOPLIN: "Mr. Roth, why did you pick out the five cities named—Detroit, New York, Chicago, Buffalo and Cleveland?"

MR. ROTH: "On page 60 of the report, 4 of those points are given, Chicago, Detroit, Cleveland and New York, and the Pacific Coast port is the fifth, which I did not take into consideration."

MR. KOPLIN: "Exactly. They knew that by taking Pacific Coast ports into consideration the spread would be the reverse: that there would not be a spread in favor of the Belgian producers as against the American?"

MR. ROTH: "From my knowledge of the report, the imports at the Pacific Coast ports were very small, almost insignificant, so I did not think it necessary."

MR. KOPLIN: "Does it not appear, Mr. Roth, by an examination of this same statement on page 60 that the average costs to the Pacific Coast ports from the domestic plants is 6.7 cents as compared with the average cost of 2.8 cents from the Belgian plants, under conversion method No. 1?" MR. ROTH: "Yes, it does."

MR. KOPLIN: "Do you consider it fair, then, to leave out of one calculation such a disadvantage against the American producers?" MR. ROTH: "Well, I considered the proportion of consumption so small at the Pacific Coast ports that I did not think it necessary to take it into consideration in order to arrive at the weighted average costs in the entire country."

MR. KOPLIN: "Why did you take Buffalo? Does not a mere examination of that statement show that the consumption at the Pacific Coast ports is considerably greater than the consumption at Buffalo." MR. ROTH: "I have not gone into that."

MR. KOPLIN: "As a matter of fact, you picked out the ones which figured more favorably to the Belgian producers?"

MR. WILSON: "Is there any statement you want to make with regard to the questions asked you by counsel on the other side, not covered?" MR. ROTH: "Yes. I have quite a list of authorities on the subject of why imputed interest should be excluded from manufacturing costs. I have not only a list of authorities, but I have photostat copies of extracts from the various books and documents which, if you desire, I shall be willing to put in."

MR. WILSON: "For the convenience of the Commission, I would like to offer the list of citation of authorities as stated by the witness, and the abstracts from those authorities which are pertinent to the issue." The list and extracts were received.

[The remainder of Mr. Roth's testimony and that of Lucien DeBay, the last witness for the applicants, and the examination of four witnesses, Samuel C. Gilmore, Powers Pace, W. J. Schoonover and Richard B. Tucker, for the opposing interests, will be reviewed in a later issue.—ED.]

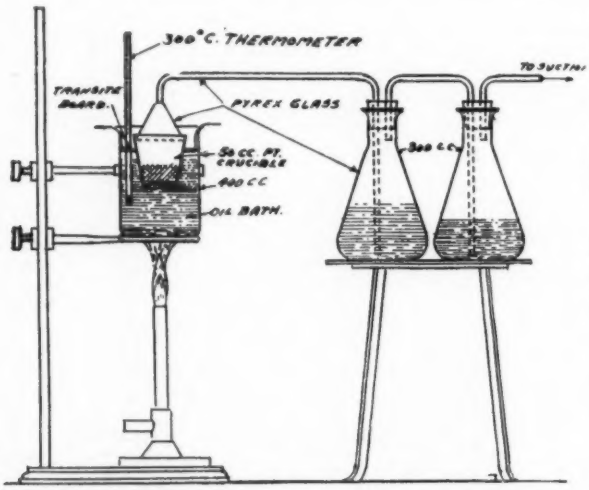
The Laboratory

Valuation of Fluorspar

Fluorspar, calcium fluoride (CaF) is used in considerable amounts in the manufacture of opal glass. This mineral is commonly found in veins and is often associated with ore minerals, especially lead. Limestone is the most important wall rock of the American deposits. The localities producing the largest amounts of high grade fluorspar are situated in Kentucky and Illinois. Smaller deposits occur in Colorado, Arizona and Tennessee.

In the western Kentucky district, which is one of the largest producers of the world, the fluorite is found as vein deposits in fault fissures cutting limestones, sandstones and shales. Associated with the fluorspar are calcite and galena.

To the glass chemist the most important determination in fluorspar is that of fluorine, since it is the element for which the material is bought. The iron determination is next in importance; then follow determinations of silica and calcium. When more complete knowledge about the material is required, determinations of aluminum, lead, manganese and magnesium may be carried out. It is needless to say that a complete analysis of fluorspar as indicated above is a time-consuming undertaking which is not often required in practice.



For commercial purposes the method of analysis worked out by Dr. E. Bidtel,[1] chemist of the Fairview Fluorspar and Lead Company, Golconda, Illinois, is generally employed. The following procedure, which is believed to be accurate is submitted for consideration of chemists.

Complete Analysis of Fluorspar

FLUORINE. The procedure is based upon the evolution of fluorine by means of perchloric acid, its absorption in suitable reagents and finally its determination as lead chlorofluoride.

1. Transfer a one gram sample of fluorspar, powdered to pass a 200-mesh sieve, into a large platinum crucible, provided with a glass still head, as shown in the sketch. (For details see notes.)

2. Support the still in an oil bath, adjust the head and pass the delivery tube to the bottom of a 250 cc. Erlenmeyer absorption flask, containing 25 cc. of 20 per cent sodium hydroxide solution, diluted to 150 cc. The second absorption flask contains 100 cc. of 1 per cent sodium hydroxide solution and 1 cc. of phenolphthalein.

3. Aspirate a stream of air rapidly through the apparatus and add 10 cc. of perchloric acid to the sample in the still.

4. Heat the oil bath to a temperature of 203-210 degrees C. for one-half to one hour, then increase the temperature to 250 degrees and continue aspiration of air until the white fumes of perchloric acid cease to be driven off.

5. Raise the still from the bath, allow to cool for a few minutes and add 5 cc. of perchloric acid and 20 cc. of water and repeat the operation.

6. Remove the still from the bath and add 50 cc. of water and agitate to dissolve the perchlorates. Filter and wash with water. (This filtrate combined with that obtained in step 9 may be used for the determination of iron, aluminum, calcium and magnesium.)

7. Place the filter paper in the distillation crucible and burn off the paper, replace the crucible in the oil bath as before, add 5 cc. of perchloric acid and 15 cc. of water and repeat the distillation.

8. Replace the sodium hydroxide absorption solution with 200 cc. of lead chloride solution, containing 20 cc. of sodium formate solution (see reagents) in the first absorption flask and 150 cc. of lead chloride solution in the second flask. Repeat the distillation.

9. Transfer the first lead chloride absorbing solution to a beaker, neutralize the free acid with 5 per cent sodium hydroxide solution, just to the appearance of a precipitate of lead hydroxide, then make acid with formic acid. If a precipitate is formed, it is an indication that there still remains some fluorine in the sample, and steps 8 and 9 should be repeated with fresh solutions in the first absorbing flask. When no precipitate is formed, the distillation is finished. Add water to the residue in the crucible, filter and wash, combining the filtrate with that obtained in step 6. The insoluble residue on the filter is retained for the determination of silica.

10. Transfer the sodium hydroxide solutions to a beaker and neutralize with formic acid, using phenolphthalein indicator. (If any silica separates, filter through a small filter paper, and wash with hot water to completely remove all of the fluoride.)

11. To the neutral clear solution, which should have a

[1] *Industrial & Engineering Chemistry*, Vol. 4, No. 3, March, 1912. Ibid Vol. 6, No. 3, p. 265, March, 1924.

[2] One hundred grams H_2O at 18 degrees C. dissolves 0.0325 gram PbFCl and 0.1081 gram at 100 degrees C.

volume of about 500 cc. add 10 cc. of formic acid and 1,500 cc. of lead chloride solution (including the combined $PbCl_2$ solutions used as absorbents) and stir well.

12. When the precipitate has settled, filter on a perforated crucible, washing the beaker with lead chloride solution. Remove as much lead chloride solution as possible with suction and then with a fine stream of water wash the side of the crucible and precipitate, using not over 10 cc. (Lead chlorofluoride is quite appreciably soluble in water.)[2]

13. Dry the precipitate at 130-150 degrees C. and weigh as PbFCl.

CALCULATION:

$$\frac{\text{grams of PbFCl} \times 0.1492 \times 100}{\text{weight of sample}} = \% \ CaF_2$$

Notes

APPARATUS. The glass still head should be blown from one-half inch to three-quarter inch pyrex glass tubing, to fit closely the inside of the platinum crucible, measuring from 50 to 100 cc. The tube is then drawn out and bent to form the delivery tube into the absorption flask. The fluorine attacking the glass to some degree is distilled over as silicon tetrafluoride. This is absorbed by the sodium hydroxide, and the silica is precipitated after making the solution neutral with formic acid, and is removed by filtration. In this way no appreciable loss of fluorine occurs.

REAGENTS. *Lead chloride solution.* Make up a saturated solution, filter before use and add 100 cc. of water to each liter.

Sodium hydroxide solution. Prepare a 20 per cent solution, filter through asbestos, allow to stand several days and again filter any precipitate that may form.

Perchloric acid. Transfer 500 grams of ammonium perchlorate, 600 cc. of water and 410 grams of 70 per cent nitric acid to a two liter flask. Heat to boiling and add 105 grams of 37 per cent hydrochloric acid, diluted to 400-500 cc. through a long stemmed dropping funnel. The acid may be run in rapidly at first, but when rapid action ensues run in slowly. The reaction may be completed in 25 minutes. Boiling must be vigorous throughout the operation. Add water slowly to replace that lost by evaporation and continue the boiling for an hour. Boil down until fumes of $HClO_4$ are given off. The acid should be free from ammonia (Nessler test). If nitric acid remains, a little hydrochloric acid and further boiling will aid in removing it.

REACTION: $34\ NH_4ClO_4 + 36\ HNO_3 + 8\ HCl = 34\ HClO_4 + 4\ Cl_2 + 35\ N_2O + 73\ H_2O$. The acid should be further purified by distillation under a pressure of 200 mm, otherwise it will slightly decompose. The product should be about 75 per cent $HClO_4$. It can be obtained also from dealers in chemicals.

Sodium formate solution. Neutralize to litmus 15 cc. of 90 per cent formic acid solution with 20 per cent NaOH solution and make slightly acid with formic acid. Then dilute to 500 cc. (100 cc = 5 grams NaCOOH).

DISTILLATION. A rapid stream of air must be aspirated through the train, sufficient to prevent loss of HF, which will be noted by white fumes of $HClO_4$, escaping from the joints of the still. For very accurate work, a platinum still, with close fitting platinum still head is required. However, the results with the improvised glass still head are remarkably accurate, provided care is taken to keep a constant stream of air going into the still, by keeping up a strong suction.

In operation 6 the soluble perchlorates are removed from the undecomposed CaF_2, and after one more distillation with $HClO_4$ the fluorine should be completely removed. Care must be taken to drive off all of the free $HClO_4$, before dissolving the perchlorates, as CaF_2 is partially soluble in $HClO_4$, and would be carried into the filtrate and determined with iron and aluminum in subsequent operations.

If desired, steps 6 and 7 may be omitted, but this requires a larger number of repeated distillations under step 9 to insure complete removal of the fluorine.

PRECIPITATION OF LEAD CHLOROFLUORIDE. The accuracy of the procedure after complete distillation and absorption depends on the proper precipitation of the PbFCl. The presence of sodium formate and sodium perchlorate in the solution does not interfere with the accuracy if the concentration of the sodium salts does not become too great, in which case it will be occluded with the lead chloride and cause results to be too high. The concentration of the sodium fluoride should not be more than .25 grams of NaF per 100 cc., or occlusion will result. The concentration of the NaF should not be less than .02 grams per 100 cc. as lead chlorofluoride will not precipitate from very weak solutions. If the concentration becomes too weak, the solution may be concentrated, while alkaline, by evaporation.

Determination of Iron

To the combined solutions obtained in steps Nos. 6 and 9 by filtration, add ammonia, until neutral, using litmus as indicator. Acidify with 10 cc. of hydrochloric acid (1:4) and dilute to 100 cc. Heat to about 90 degrees C., saturate with hydrogen sulphide gas, filter and wash with saturated hydrogen sulphide water. The precipitate of lead sulphide may be reserved for the determination of lead.

Evaporate the filtrate until all hydrogen sulphide is expelled, add a few drops of nitric acid and continue the evaporation until the volume is about 100 cc.

Add methyl red indicator, and precipitate iron and aluminum as the hydroxides by addition of a slight excess of ammonia.

Filter and wash. Reserve the filtrate for the determination of manganese. Ignite the precipitate and weigh as the combined oxides of iron and aluminum. Iron is then determined by one of the usual methods.

Lead, silica, lime, magnesia and manganese may be determined, if desired, by standard methods of analysis.

CATALOGUE OF OPTICAL AND GENERAL SCIENTIFIC INSTRUMENTS. 336 pp. quarto, fully illustrated, paper cover. Price 6s. net. Postage extra. The Exhibition to which this catalogue relates was held in connection with The Optical Convention, 1926, at the Imperial College of Science and Technology, South Kensington, London, S.W.7, in April 12th to 17th, 1926. The book is intended as a permanent work of reference to British optical manufactures at the time of the Convention, and contains full illustrated descriptions of the instruments and apparatus exhibited by the leading makers in Great Britain. It is indispensable to all users of optical appliances. Descriptions of the Experimental and Research and Historical exhibits at the Convention are also given. Orders for the Catalogue should be sent to a Bookseller or to the Secretary, The Optical Convention, 1926, 1 Lowther Gardens, Exhibition Road, London, S.W.7.

The Glass Industry

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CONTRIBUTIONS

THE EDITOR welcomes practical articles on all subjects related to GLASS MANUFACTURING. Such articles, if accepted, will be paid for at our usual rates.

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Men and Machinery

In the *Monthly Labor Review* of the United States Bureau of Labor Statistics and reprinted in part in our preceding issue, is perhaps the most interesting document on the glass manufacturing industry that has ever left the Government printing press. With a felicitous manner of expression, not often associated with statistical matter, the author outlines the enormous changes which have taken place in the glass industry during the past quarter of a century. He points out how the introduction of machinery has affected the lives of the glass workers and of their children.

The reduction of the amount of heavy toil in the industry, and its effect on the happiness of the glass workers, both young and old is indeed the most valuable contribution of engineering science to the glass industry. It is significant to note that the greatest benefactor to the glass workers, the man who has done more than anyone else to reduce the heavy labor, associated with glass manipulation, was one who in his youth knew what it meant to work long hours for small pay at monotonous labor, Michael Owens.

The great social value of the introduction of machinery in the glass industry is the fact that the more tiresome and uninteresting part of the manufacturing process has been taken over by the lifeless mechanism, leaving to the worker the much more stimulating function of directing and regulating, of choice and decision. No machine process can be called perfect as long as it requires the monotonous work of man to supplement the movements of its mechanism. As engineering science progresses, these "missing links" in automatic operation are eliminated, one by one.

To the glass industry, machinery, of course, means greater output at smaller cost, resulting in larger profits. But in the final essence, tools and machinery are but the means of emancipating humanity from the slavery of routine, from the execution of movements, thousands of times repeated, and to divert human energy to the work of directing and selecting. Contrast Pharaoh's slaves who built the pyramids with the engineers who operated steam shovels which dug the Panama Canal, and one has a picture of the transformation which has taken place in the window and bottle glass industry in the course of a generation.

Muscular labor is being transformed into more valuable and more enjoyable mental effort. This is the great contribution of modern engineering science to the happiness of mankind: that it increases the value of human beings to themselves and to the community in which they live.

The Standards Yearbook

How the United States Government, through the Bureau of Standards and through other agencies is aiding American industry is described in an interesting manner in the Standards Yearbook for 1927, recently issued. A perusal of this publication cannot fail to impress the reader with the importance of the National Bureau of Standards to everyone concerned with industrial work. Not only does the work of the Bureau affect the fundamentals of every industry, it also goes into considerable detail, working out individual problems of value to various industries.

To the glass industry, in common with all industries depending on high temperatures, the work of the Bureau on pyrometry, thermometry, standard temperature scale and standardization of rare metal thermo-couples is of great value. Among other activities of this institution of interest to the glass industry are the standardization of eye protecting glasses, the utilization of gas, the measurement of the viscosity of glass, the study of tank block corrosion, the standardization of methods of chemical analysis and the distribution of standard samples, used for the checking of analytical methods.

The standardization activities, inaugurated by Secretary Hoover, with which the Bureau of Standards is in close cooperation have added hundreds of millions to the wealth of the United States. Present day development of industry would have been impossible but for the efficient aid which manufacturers are receiving from institutions, such as the Bureau of Standards. It would be difficult to overestimate its effect on the general prosperity which the country is enjoying at the present time.

Correspondence

Greenland Kryolith

To the Technical Editor of THE GLASS INDUSTRY,
Dear Sir:

In reading over your article, "Manufacture of Light-Diffusing Glass," I note in your reference to Greenland kryolith, "The silica which may range as high as 4 per cent is, of course, not injurious, etc."

For your information I am giving you a typical analysis of our usual run of production as shipped to the glass and enamel trade:

Sodium	32.63
Aluminum	12.82
Fluorine	53.92
Kryolith	99.37
Silica, SiO_2	0.04
Total Iron as Fe_2O_3	0.10
Undetermined	0.49
	100.00

As a matter of fact the purity of the natural kryolith has surpassed many samples of the synthetic material which we have tested within this last year or two; the silica and the iron being much higher in the synthetic material.

The iron contained in the crude Greenland kryolith is magnetic and removable by us to the percentage as given above, whereas the iron contamination in the manufacture of synthetic kryolith is non-magnetic and cannot be removed.

PENNSYLVANIA SALT MFG. CO.
(Signed) E. HUTCHINSON.

Pittsburgh, Pa., May 7, 1927.

Technical Consultation Service

Cleaning Paint and Silver from Old Mirrors

QUESTION (108)—Please give us the most up-to-date method of cleaning off paint and silver from old mirrors, which require resilvering. At present we take the paint off on a table with caustic soda, and then sponge it with nitric acid to take off the silver. The method is very messy and we lose a good deal of the nitric solution. Is there any method whereby the mirror could be put into a bath, which will remove both the paint and the silver, and if so, what would the bath be made of?

ANSWER—In regard to cleaning off paint and silver from old mirrors before resilvering we suggest that you use a solution of nitric acid and water, 50/50. The tank should be large enough to accomodate several mirrors at one time, and should be lined preferably with asphalt pitch which should be tempered with tar. The pitch should be applied to the tank in a molten state. It is advisable to cover the inside of the tank with chicken fence wire, ends and sides and bottom. A piece of wood is then fastened to give the desired thickness to the pitch, which should be ⅜ to ¼ inch or sufficient to cover the wire completely. The tank should be level when the pitch is applied, that is, when it is applied to the sides it should be laid on the floor with the side to the floor and so forth all over the tank until it is completely lined.

A lead lined tank with the seams burned in can also be used for holding the nitric acid solution.

By using the 50 per cent nitric acid solution the silver will then be changed to silver nitrate and when the solution becomes saturated the silver will crystallize out and can be sold or recovered as silver chloride.

Window Glass in the Making

Among the features that attract the attention of readers of the little book, "Window Glass in the Making" by William L. Munro, president and general manager of the American Window Glass Company, who published it some time ago for private circulation, is the author's account of an attempt made by him to verify or disprove the possibility of producing glass in the open air with a wood fire and no materials other than sand and soda, as described in the frequently quoted story of the origin of glass by C. Pliny, the Second, in his history of the world, vol. 36, chapter 27.

This is the classic of traders or sailors who, unable to find stones on the shore of the River Belus in Phoenicia on which to mount a tripod and pot for cooking purposes, resorted to the use of lumps of nitre taken from their ship's cargo and later discovered that the nitre, containing a large percentage of soda, had acted as a flux on the sand and produced in crude form, the substance now known as glass.

Pliny's account seems to have aroused a good deal of skepticism in recent years in persons who doubted the possibility of obtaining heat enough from an open fire to melt the sand, and Mr. Munro appears to have been the first one to put the matter to a practical test. He is quoted as follows:

To demonstrate the possibility of the discovery of glass in some such manner, we recently caused a wood fire to be made in the open air. Small logs were laid on a bed of glass sand mixed with an equal quantity of carbonate of soda. In order to secure accurate information of the degree of heat that could be obtained from such a fire, a standard pyrometer couple was inserted into the bed, and frequent readings taken. The fire was kept burning about two hours. The highest reading, 2210 degrees Fahrenheit, was obtained when the fire had been reduced to a mass of burning charcoal. After the fire had completely burned itself out, the wood ashes were removed and a portion of the bed was found to be fused into a vitreous mass—the same kind of glass discovered by the Phoenicians. In a similar demonstration, with a bed of glass sand mixed with an equal quantity of nitre, a like result was obtained; but when a bed of glass sand unmixed with any other ingredients was used and subjected to the same kind of a fire, there was not the slightest trace of any fusing of the sand.

It seems quite plausible, therefore, that glass was first made somewhere along the shore of the sea. Many centuries after Pliny, it was found that when seaweed was burned, its residuum, called "kelp," contained a large amount of carbonate of soda. Subsequently this was used in making glass, and there became known to the trade the term, "kelp glass."

It requires no great stretch of the imagination to think that at some time there had been kindled along a sandy shore a great bonfire of dry seaweed, with perhaps a lot of driftwood, which left amid its charred embers the vitreous mass we now call glass.

Owing to the impurity of the raw materials and to the cruder methods of manufacture, the glass made by the ancients was not the bright, clear, transparent article in use today, but was much darker and contained many bubbles and foreign particles, which made it more translucent than transparent. Saint Paul refers to this feature when he says, "For now we see through a glass, darkly"—I Cor., xiii, 12.

Centuries elapsed before this discovery by the Phoenicians was put to any practical use. In fact, we may say that glass really had to be rediscovered before glass articles of any kind could be produced.

Mr. Munro's book contains 105 pages, largely devoted to an interesting description of the cylinder process of manufacturing window glass, and is illustrated with a number of artistically executed tinted drawings showing the operations involved in this process. A large amount of information of both general and specific nature regarding window glass is also given.

Glass Container Association Decides to Raise Big Publicity Fund

Aggressive Action to Promote Use and Increase Sales of Their Products

One of the best attended, most enthusiastic and eventful meetings ever held by the Glass Container Association took place May 5-7 at Atlantic City, where a large number of members gathered in their eighth annual convention and took action on important matters which had been under investigation by the Association's executives and committees for some time past. Chief among the developments was the adoption of the report by I. R. Stewart of the Anchor Cap and Closure Corporation, and chairman of the Association's publicity committee, on plans for increasing the use and sales of products packed in glass containers, and the decision of the members to assess themselves as individual concerns for donations equal to one-quarter of one per cent of their total sales for the year 1926. This will produce a substantial income that will be expended by the Association under the control of the board of directors for "the employment of direct advertising to educate the public to a better appreciation of the advantages of glass as a container, by indirect advertising for the same purpose, by promoting and assisting advertising by allied associations of the users of glass containers, and/or by the employment of such local and national methods of publicity and merchandising and/or by such other means as may seem to the board of directors most conducive to the greater sales of glass containers and glass packed products."

After hearing what President Ferguson had to say on the subject Friday morning, so strong was the sentiment of the members in favor of adopting the proposition that representatives of several manufacturers insisted on signing contracts immediately to contribute for the whole three-year period during which it is proposed eventually to continue the campaign, and were only dissuaded from doing so when it was pointed out that all the plans and preparations had proceeded on the one-year basis, that this was what the directors had authorized and that a change now in the length of the period would cause confusion and delay.

The members' contributions are to be paid in four quarterly instalments beginning July 1, 1927. Their contracts contained a proviso that rendered them ineffective until member manufacturers of containers and closures whose aggregate net sales amounted to at least 80 million dollars in 1926 had executed like contracts. A substantial number of signed contracts or definite assurances, including those of nearly all of the largest and leading glass container manufacturers, were handed in at the meeting, or soon after. This assured at once unanimous co-operation and the receipt of a fund of at least $200,000, sufficient to finance the project successfully during the first year.

An example of the good spirit prevailing throughout the Association and the willingness of individual members to be of use to the whole industry has been disclosed by the announcement that the Illinois Glass Company has released Mr. Ferguson, who has been the effective president of the Glass Container Association for three years and has just been re-elected, from his important duties as secretary of that company, for a period of several months, long enough to enable him to make headquarters at New York where he can co-operate most effectively in putting through his important plans for further extending and strengthening the organization, work, and influence of the Association.

SOME OF THOSE ATTENDING THE EIGHTH ANNUAL

On the opening day of the meeting, May 5, after the usual "get-together" amenities in the morning, which were particularly enjoyable because of the large attendance, a business meeting was held in the afternoon at which committee reports were heard. Chairman J. S. Algeo of the statistics committee, Fred J. Rummel, director of the statistical department; S. Henry Ayres, director of the traffic department, and J. C. Magness, presented their reports of committee activities and accomplishments. The subject of advertising was again reverted to in an address by Andrew H. Mellville, director of research for the Condé Nast group of publications—*Vogue, Vanity Fair* and *House and Garden*, who talked on successful methods of increasing sales through advertising.

Friday, May 6, was a big day. The excellent condition of the Association's finances was reported at the morning meeting by the treasurer, Robert E. Walker of Turner Brothers Company.

Judge Jennings submitted his report as business manager and President Ferguson presented with fervor and conviction an address on "Our Industry and Its Association."

The annual election held at this meeting resulted in all the executive officers being returned again to their previous posts, as follows: President, Frank F. Ferguson; first vice-president, W. H. McClure; second vice-president, P. I. Heuisler; secretary and treasurer, R. E. Walker and I. G. Jennings business director. The resignation from the board of directors of F. H. Baldwin, who recently relinquished the management of the Thatcher Manufacturing Company, and of A. H. Grier of the Dominion Glass Company, and T. L. Briggs, were received and H. C. Mandeville, James King and T. F. Hart were elected respectively to succeed them. Directors James H. Graham, P. C. Doyle and E. F. Glacken, whose terms had expired were re-elected.

At the morning session the members were treated to an address by A. Harry Moore, Governor of the State of New Jersey. Mr. Moore, a celebrated orator, captivated the audience. His fund of humorous stories seemed inexhaustible and he was adept at using them to clinch the points he had tried to drive home to his hearers. The latter part of his address was inspirational, emphasizing the importance of business men making the most of every present opportunity instead of wasting time bemoaning the lack of some fancied advantages.

By President Frank F. Ferguson

"There is a tide in the affairs of men,
Which, taken at the flood
Leads on to fortune;
Omitted, all the voyage of their life
Is bound in shallows,
And in miseries."

The dangers that threaten the industry—excessive stocks, overproduction and indifference to the general welfare, are dangers with which the Association ought to be able to cope. We are all informed that the industry has been operated at about 72 per cent of its capacity. The orders booked during the past six months were higher than during the previous six months, but the shipments have not increased in like proportion, while the operating capacity is excessive. The capacity has been increased unduly in spite of the fact that the stocks were already too large. New furnaces have been built under these conditions, and the old bugbear of excessive stocks and overproduction is still with us. If we all operate beyond the market requirements and if the law of supply and demand is ignored, then the "voyage" will end not only in "shallows" but on the rocks. A "flood" of bottles far beyond the requirements of the market will scarcely "lead on to fortune."

What our Association is striving for is to encourage and benefit the industry by supplying those guides, activities and information that will produce practical results, to establish harmony and a co-operative spirit, to keep the membership informed and to avoid guesswork about the supply and demand, to point out that there is a common interest between us. There our work must end. If in spite of the guide posts some persist in trying to drive down the wrong side of the road and have a head-on collision, that the Association cannot prevent. We believe, however, that the Association is approaching the "flood tide" of its usefulness, and that it will bear its members safely on beyond the "shallows."

It takes time for the real need and purpose of an Association like this to make itself felt in the different branches of the industry. The idea of competition is so deeply rooted in the business world that the thought of association seems at first novel and unpromising. It has taken time for the members to digest and assimilate the statement I quoted last year—"A Trade Association *serves* where the individual *acts*, it *instructs* where the individual *learns*, it works *for* the individual but never *instead* of him." But time enough has elapsed since the founding of this Association for prejudice to be overcome, indifference to be awakened, selfishness to be curbed. Committees and individual members of the Association have labored zealously and unselfishly to aid the

CONVENTION OF THE GLASS CONTAINER ASSOCIATION

The recent death of Palmer Winslow of the Winslow Glass Company drew forth many expressions of regret and a resolution of sympathy for the family was fittingly presented by H. L. Dixon, an old friend of Mr. Winslow's, and passed by the meeting.

During the Friday afternoon meeting, James Moore, president of the New York Canners, Inc., addressed the members on "Developing Markets for Fruits and Vegetables by Advertising and Publicity." He gave his hearers an insight into the large possibilities of extending their markets by developing the use of glass containers for new products. He pointed out numerous advantages the glass containers possess for marketing food products.

It was at this meeting that I. R. Stewart presented the publicity committee report and recommendations for financing the advertising and publicity campaign, which, as stated above, was enthusiastically adopted without opposition.

The ladies who accompanied their husbands to the seashore resort were well taken care of and entertained by the women's committee. The golf devotees had their "innings" on Saturday at the Atlantic City Country Club.

Some abstracts from President Ferguson's address follow.

rising "tide," but greed or ignorance may yet prevent the Association from reaching the "flood tide" of influence and usefulness which "might lead on to fortune" for one and all.

Under the present plan of organization the activity of each department is under the control of a committee appointed by the president, on the theory that the work of the Association is so very important that the men who have their money invested in our firms should be kept in close touch with each department, and thus through their practical knowledge of the industry, pilot it wisely and safely on our "voyage."

COST ACCOUNTING: At our meeting in Montreal last year I made certain recommendations about extending the work of the Association, the first of which was a recommendation favoring the installation of the uniform system of cost accounting. That system has now been installed and is functioning actively and properly to the best of my knowledge and belief.

PRESIDENT FRANK FERGUSON

GROUP PLAN: The second recommendation was the formation, within the Association, of groups making similar classes of ware. One or more of such groups has since been formed and I believe that as the idea becomes better understood, that the recommendation will be followed almost completely.

CO-OPERATIVE ADVERTISING: A recommendation favoring this idea was also made last year. Co-operative advertising was one of the primary objects of the Association when it was formed. Advertising by the individual firm is always selfish and highly competitive, but a co-operative plan, nation-wide in its scope, is a joint effort to extend the use of glass containers.

If we have been operating at 72 per cent of capacity, then we need not 28 per cent but 40 per cent more business to fill up. The plate glass industry increased their business 68 per cent by a three-year co-operative advertising campaign. We need 40 per cent increase. Remember the old adage "The Lord helps those who helps themselves."

There was a Canned Foods Week campaign held recently, and to that work this Association doubled its contribution of last year. But in addition to making that contribution, a plan was worked out whereby the glass container itself secured some very broad and favorable publicity.

A demonstration of glass packed articles in the retail stores of several cities is now going on. Here newspaper publicity has been used, the jobbers and wholesalers have been asked to co-operate and a woman skilled in publicity work and domestic science is visiting the retail stores in these cities where glass packed displays are exhibited, and is thus trying to meet the ultimate user, learn what she can of the customer, get the housewife's opinion of glass packed products, and cause as many as possible to think, not only of the contents, but of the glass itself and its superiority.

Definite progress has been made in packing of meats, fish, fruits, vegetables, etc., in glass, and we are much encouraged over certain matters that have happened recently. We are trying to show the public the importance of a transparent container, of the value of our slogan—See what you Buy, Buy in Glass—and we have been trying to teach them that it is the quality in the glass jar and not the jar itself, for which they are sometimes asked to pay a higher price.

So, therefore, we have been going forward in what I termed last year the new, honorable and necessary job of changing the art of canning back to the art of bottling. As our business grows and as matters become more complex, there comes a time when we must make sure that we are not trying to do "big" business in a small or narrow way, for the larger the industry grows the greater the need of modern ideas, of broad and liberal policies, of wise leadership.

My question is, now that we know the facts, what are we going to do about them? Are we going to make the Association the standard-bearer that will lead us on and up to new heights and around which we can rally in time of need? Are we going forward intelligently and co-operatively, or is it going to be every fellow for himself? Do we imagine that we can run our fellow manufacturer out of business, that we can stand something that he cannot stand? If we fail to boost our business jointly and sell our common product to the public on its *real merits*, then the rival, the substitute or the competing product will take the "tide," while we sing with the mournful poet—

"Omitted, all the voyage of their life
Is bound in shallows,
And in miseries."

On the other hand there is nothing impossible ahead if we will but act with intelligence, if we will but stop, look and listen, if we will but choose the right road, if we will but keep in mind, not our own selfish interests alone, but those of the public and of this great industry as well.

There is more work to do, that is true, but we have set up within the Association the machinery with which to do the work and to guide our respective courses safely. We now know better than we once did what a trade association can legally do, and if instead of fighting and tearing down we will but face the facts, if we will but study and supply the industry's needs, build it up, enlarge its scope, extend its use, then, to a degree we can forget the internal competition, for then we will have the big thing we now lack—a *public demand* for the *glass* packed article; thus we will put new products into our wares, for the buyer is "boss" and will not be denied. That is not a one man's job, but requires a long pull, a strong pull and a pull all-together; that is the way of progress and of modern business, that is the straight road to success, that is why, so it seems to me, Shakepeare truly aid—

"There is a tide in the affairs of men,
Which, taken at the flood,
Leads on to fortune."

Obsolete Versus Modern Equipment

William Feather, in a bit of business philosophy says: "The industrial success of America rests on our willingness to throw out the old and inefficient and install the new and efficient. High wages have compelled us to adopt this policy, because the only chance the American manufacturer has for survival in the world market is by employing machines to do his work. In this situation the business man who would like to play safe finds himself 'left on base.' Alert competitors, awake to the possibilities for improvements, surge forward, and the mossback dies.

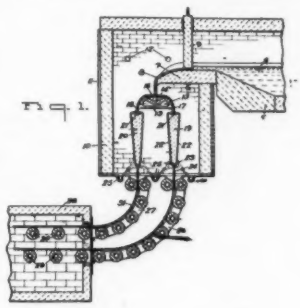
"The most priceless asset of any industry is an open-minded management, keenly alive to the necessity for everlasting self-scrutiny. What can we do to improve our product? To reduce its cost of manufacture? To better our service? To facilitate distribution? Unless an executive is willing to face this daily cross-examination he might as well retire from business. He certainly cannot keep his place if he resists progress."

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

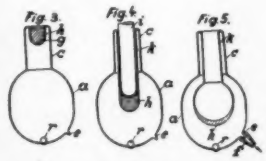
Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

MULTIPLE-SHEET-FLOWING APPARATUS. U. S. 1,623,051. Apr. 5, 1927 Frank Frazer, Toledo, O., assignor to Libbey-Owens Sheet Glass Company. Filed 5/16/25. A furnace containing a mass of molten glass, means to permit a flow of glass from the furnace, an adjustable intercepting member, a plurality of adjustable slabs arranged in proximity to the intercepting member whereby glass flowing from the furnace will be divided into plurality of streams, each of the streams flowing upon a slab to produce a plurality of sheets.



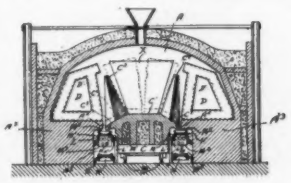
APPARATUS FOR ANNEALING GLASSWARE. U. S. 1,622,663. Mar. 29, 1927. Vergil Mulholland, West Hartford, Conn., assignor to the Hartford-Empire Co. Filed 9/29/25. Apparatus for annealing glassware comprising a tunnel having a corrugated floor, said corrugation forming a series of ridges and depressions, a heating flue extending beneath said floor, a conveyor extending above said floor and supported directly by said ridges, and means for preventing the flow of air through said depressions.

METHOD OF MANUFACTURING DOUBLE-WALLED GLASS VESSELS. U. S. 1,623,311. Apr. 5, 1927. Wilhelm Hodecker, Ilmenau, Germany. Filed 5/4/26. This invention consists in first blowing the outer wall of the vessel and providing the same at its top with a cap, thereafter causing the said cap to sink into the vessel in the form of a cup, filling so much glass into the said cup, as is needed for forming the inner wall, and finally forming the cup and the glass filled into the same into the inner wall of the vessel. In forming the inner wall of the vessel by expansion of the cup and mass of glass sunk into the same, use is made of differential fluid pressure.



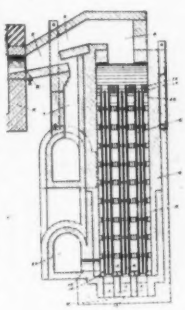
APPARATUS FOR MAKING TRANSPARENT SHEET GLASS. U. S. 1,624,283. Apr. 12, 1927. George A. Shields, Columbus, O. Filed 2/3/26. In an apparatus of the character described, a flow chamber having an opening in the bottom thereof, and a pair of stationary cylindrical fluid cooled forming members arranged beneath said opening and spaced from each other.

KILN FOR GLASS MELTING AND LIKE PURPOSES. U. S. 1,623,779. April 5, 1927. George E. Crawford, Trenton, N. J., assignor to the American Dressler Tunnel Kilns, Inc. Filed 10/19/23. In a tunnel kiln adapted for use in glass melting, comprising an elongated kiln chamber, heating means therefor, and a movable hearth separated from a portion of the kiln structure at one side of the hearth by a clearance space, the improvement which consists in a conveyor located beneath said clearance space and extending longitudinally of the latter and adapted to carry material passing onto the conveyor through said clearance space out of the high temperature zone of the kiln chamber.



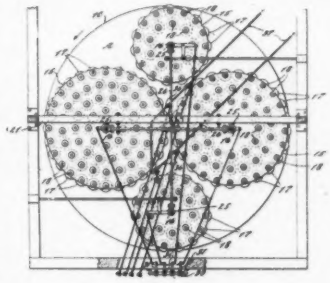
DEVICE FOR CUTTING GLASS TUBES OR RODS. U. S. 1,624,197. Apr. 12, 1927. Ernest Abelt Karnap, near Essen-on-the-Ruhr, Germany, assignor to The Libbey Glass Co. Filed 10/29/26. A device for automatically severing a continuously moving glass tube or rod into separate sections comprising a cutting tool of hard and porous material, means for resiliently mounting said tool, and means for keeping said tool moist.

RECUPERATOR. U. S. 1,624,128. Apr. 12, 1927. Walter O. Amsler, Pittsburgh, Pa., assignor to Amsler-Morton Co. Filed 9/27/22. A recuperator in which the gases have a more or less free circulation around the pipes. With this arrangement, if one pipe tends to become hotter than the others, laws of convection divert their flow to cooler parts of the chamber through which they pass. Consequently other pipes become heated, while that which was receiving most heat is cooled by the greater volume of air induced through it. A stabilized condition, which maintains a substantially constant flow through each pipe, with a corresponding even distribution of heat, resulting in an even heating of the air with a maximum absorption of heat from the waste gases.



POT FOR GLASS-MELTING FURNACES. U. S. 1,625,345. Apr. 19, 1927. Gerhard Stein, Neusornewitz, Germany. Filed 6/24/26. The inventor claims that a complete use of the heating or fire-gases touching the bottom of the pot is ensured by arranging open grooves or passages on the under surface of the bottom of the pot, said grooves or passages running parallel with each other or crosswise from edge to the opposite edge in such a manner that the heating or fire-gases are drawn through said open grooves or passages and the heat is supplied to the bottom of the pot in permanently fresh quantities.

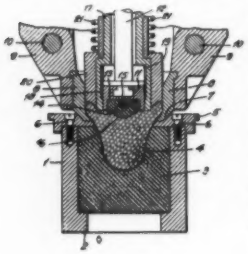
METHOD OF AND APPARATUS FOR POLISHING. U. S. 1,624,290. Apr. 12, 1927. Wm. Taylor and Francis W. Preston, Leicester, England. Filed 2/21/22. The friction between the work and the blocks tends to move each polishing member in the direction in which the table moves beneath such member, and this drag on the member causes a stress on its lower shaft bearing 25 in the direction of movement of the table beneath the bearing. This stress causes a slight movement of each of the bearings 25 against the elastic resistance of its supporting arm 26, the amount of which movement varies according to the amount of frictional resistance between the polishing member and the work. Such movement of the bearing is recorded by its recording device 30, and the supply of polishing material is manually regulated through valve in accordance with the variation in such frictional resistance as shown by the recording device.



PROCESS FOR MANUFACTURING HOMOGENEOUS GLASSLIKE CONDENSATION PRODUCT OF UREA AND FORMALDEHYDE ["Pollopas"]. U. S. 1,625,283. April 19, 1927. Kurt Ripper, Vienna, Austria, assignor to Fritz Pollak. Filed 9/9/22. 60 parts by weight of urea, 150 parts by weight of 40 per cent solution of formaldehyde (40 per cent by volume) and 6 parts by weight of hexamethylenetetramine are heated under reflux in a water bath until test samples do not become cloudy when cooling down. Gela-

tinization sets in after a short time, if one part of potassium sulphate (or potassium nitrate or potassium chloride or potassium chlorate or potassium iodide or potassium sulphocyanate, etc.) is added to 100 parts of the condensation product thus obtained. The gelatinous mass being allowed to stand in the cold, water begins to separate therefrom. The material may now be hardened by letting it stand in the cold, care being taken, that the water is eliminated.

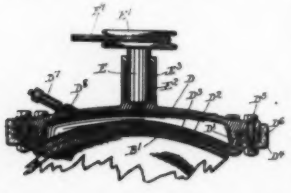
APPARATUS FOR SHAPING GLASSWARE. U. S. 1,625,590. Apr. 19, 1927. Robt. W. Canfield, West Hartford, Conn., assignor to Hartford-Empire Co. Filed 6/26/26. The inventor states that a blank mold of non-metallic material such as carbon compositions ordinarily used in making electric bulb molds, does not produce surface irregularities. The blanks produced in such a mold resemble hand-marvered blanks and produce bulbs, tumblers and other paste-mold ware having better distribution and greater freedom from defects than has been produced before by automatic machinery.



GLASS POLISHING MACHINE. U. S. 1,626,026. April 26, 1927. Chas. W. Dake and Robert S. Levis, assignors to Pyle National Co. Filed 10/2/22. In a glass polishing machine, a mandrel upon which the work is mounted for rotation, a spider mounted for rotation about an axis inclined to the axis of rotation of the work, a plurality of separate polishing pads, each pad being rotatably mounted upon the spider, a pivoted support for the spider, the spider being free to move toward and from the work, the spider being held against the work by gravity and being adapted to be rotated by engagement of the pads with the work.

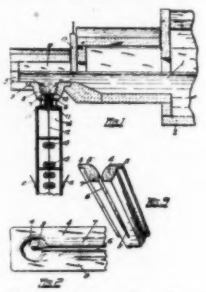
METHOD AND APPARATUS FOR FORMING GLASSWARE. U. S. 1,627,428. May 3, 1927. Edward Danner, Toledo, O. Filed 8/23/20. The method, consisting in causing molten glass to flow along a directing means and around opposite sides of a tip portion disposed at the discharge end of the means, the glass merging at the outer edge of the tip portion and flowing therefrom in single sheet form.

GLASS-POLISHING MACHINES. U. S. 1,626,025. April 26, 1927. Chas. W. Dake and Robert S. Levis, assignors to Pyle-National Co., Chicago, Ill. Filed 10/2/22. Machine for polishing the outside of a glass reflector bowl for locomotive electric headlights and the like. The air chamber may be filled with compressed air and the polishing pad inflated to any suitable pressure. The felt element will have on the surface where it engages the bowl a suitable supply of rouge or other polishing abrasive, and the fact that the working portion of the pad is held against the bowl by air pressure only causes the surface of the pad to conform absolutely to the previously arranged contour of the bowl and therefore as the polishing continues no change in shape of the bowl can take place because the pressure of the various portions of the pad where they press upon the bowl is always the same for every unit of area.

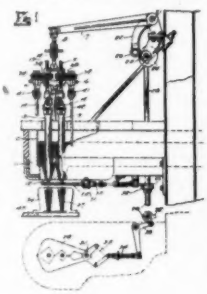


GLASS. U. S. 1,626,042. Fred M. Locke, Victor, N. Y. April 26, 1927. Filed 8/28/16. Renewed 10/29/26. The inventor, by the elimination of the alkali carbonates and the use of alkali nitrates, such as potassium nitrate or sodium nitrate, in connection with boro-silicate glasses, is able to obtain a glass of lower expansion with less brittleness, and, in connection with some batches, a pure white transparent glass may be obtained, where the same would be impossible with batches employing alkali carbonates. One example of a batch made in accordance with this invention: 80 parts silica or 10 parts boric acid, 10 parts alkali nitrates, as for instance; 5 parts potassium nitrate; and 5 parts sodium nitrate. 10 parts cryolite. And 1 part lepidolite. The lepidolite facilitates the working of the glass but is not essential for some of the features of this invention. The fluorine in the cryolite permits the silica to be fused at a lower temperature and in this way permits the use of a greater amount of silica.

FORMING SHEET GLASS. U. S. 1,626,382. Apr. 26, 1927. James C. Blair, Toledo, O., assignor to Libbey-Owens Sheet Glass Co. Filed 2/18/24. In an apparatus for producing sheet glass, a container for molten glass comprising a member in the bottom thereof having an elongated vertical slot through which the molten glass flows to form the sheet, the slot being narrower at its ends than at its central portion, means for cooling the glass as it emerges from the slot, and a closed annealing chamber through which the glass passes downwardly. To provide for the more rapid flowing rate through the narrow ends of the slot, as well as to prevent excessive cooling and the formation of "dog-metal" or devitrified glass, the large bowl-shaped receptacles 10 are provided.

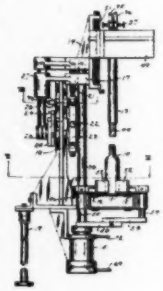


MEANS FOR FORMING CHARGES OF MOLTEN GLASS. U. S 1,626,737. May 3/27. R. LaFrance, Toledo, O., assignor to Owens Bottle Co. Filed 9/30/21. The combination of a glass furnace having an extension communicating therewith, said extension having a plurality of outlet openings through which the glass issues simultaneously to form a plurality of charges, regulating means by which the issuance of glass through each outlet opening is independently controlled, whereby the relative sizes of the charges of glass issuing from the respective outlets may vary, and means below the outlets to sever the plurality of charges of glass as they issue from the feeder above.



DRAWING SHEET GLASS. U. S. 1,626,395. Jos. P. Crowley, Toledo, O., assignor to Libbey-Owens Sheet Glass Co. Filed 7/14/22. In an apparatus for producing sheet glass, an endless metal belt upon the upper horizontal run of which the sheet is formed and flattened, supporting means within the belt loop for the upper run of the belt, a series of rotating polishing discs acting upon the lower return run of the belt, and a common driving means for the belt and polishing discs.

METHOD AND APPARATUS FOR FIRE-FINISHING GLASS ARTICLES. U. S. 1,626,739. May 3, 1927. J. M. Lents and F. R. Miller, Evansville, Ind., assignors to Graham Glass Co. Filed 3/26/24. The present method of fire finishing bottles is entirely distinct from and in marked contrast to the ordinary fire finishing method heretofore in extensive use, which consists in applying a flame which heats and softens the entire body of glass within the fire finishing area before the surface is softened sufficiently to take a fire finish. With this old method, the heating was gradual and operated to increase and open up the checks or cracks rather than to smooth them over and close them up with melted glass. In the present invention, the heat of the flame is much more intense, is localized, and acts much more quickly to melt and glaze the surface of glass acted upon.



MACHINE FOR DEFORMING GLASS ARTICLES. U. S. 1,626,683. May 3, 1927. Harry D. Madden, assignor to Westinghouse Lamp Co. Filed 12/10/20. An automatic machine for providing a construction in tubes intended for use in the manufacture of the tipless lamps.

GLASS GATHERING RING. U. S. 1,628,465. May 10, 1927. Leon J. Houye, Point Marion, Pa. Filed 11/20/26. A float or so-called gathering ring for the gathering of molten glass, equipped with means whereby a minor quantity of glass of a different color than that of the main molten body may be supplied to the surface of the molten body at a small area within the gathering opening, so that the operative may obtain a gather of the molten glass base with a minor quantity of molten glass of a different color picked up upon the surface of the gather. The gathering ring is equipped with a hearth or shelf, upon which the colored glass may be melted and from which it will flow out upon the surface of the main molten body in the gathering opening. When it is desired to cut off the flow of the colored glass, the clay ball 11 is pushed out of its receptacle into the channel 8, and the flow is cut off.

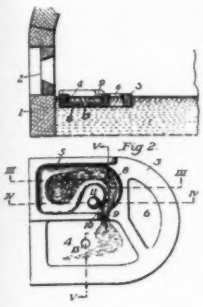
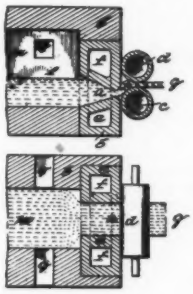


Fig 2.

PROCESS AND APPARATUS FOR MAKING SHEET GLASS. U. S. 1,628,353. May 10, 1927. Louis Bodin, St. Gobain, France, assignor to Société Anonyme Des Manufactures Des Glaces & Produits Chimiques De Saint-Gobain, Chauny & Cirey, of Paris, France. Filed Apr. 27, 1926, and in France 10/9/24. The process of feeding molten glass through a submerged issue opening of a glass container to a forming pass which comprises causing the glass to issue in a substantially horizontal direction in a highly heated condition through the issue opening under the head pressure of glass above the opening, and moving the glass issued from the opening to the forming pass at a rate which permits the creation under the head pressure of a meniscus on the glass outside of the opening.



MOLTEN GLASS FEEDING MECHANISM. U. S. 1,628,238. May 10, 1927. Enoch T. Ferngren, Toledo, O. Filed 2/23/12.

Glass Factory Equipment and Supplies

Most of the information printed in this department comes direct from the manufacturers of the products described.

Western Deposit of Sodium Sulphate Now Being Developed Commercially

About 65,000 tons of sodium sulphate are used annually in the United States in the processes of glass manufacture. An abundant supply of this substance, is important for the industry. It is interesting, therefore, to know that the Far West now is developing a large deposit of this material which, it is stated, meets in every way the requirements of the glass manufacturers. Not only is this deposit abundant. it practically is inexhaustible, but also it is readily accessible, lying so near the surface of the ground that it easily can be quarried with the minimum of labor and expense, and even in its natural state it is said to be of extreme purity.

QUARRY AND MILL OF THE SODIUM PRODUCTS CORPORATION, NEAR PRESCOTT, ARIZONA

The deposit was discovered a few years ago and for a period was quarried by a concern then known as Western Chemicals, Inc. It lies in a mountainous region in the Camp Verde Valley of Arizona, a few miles from the city of Prescott. The deposit is of unknown extent, but that it is enormous has been proven by the quantity that already has been exposed and by some unavailing investigations to determine its magnitude. The breast of the quarry now exposed is from 50 to 70 feet in height and lies exposed for several hundreds of feet laterally. Recently a shaft was sunk through it to a depth of 80 feet without running out of the deposit. It is estimated that in that portion of the deposit now lying ready to the hand there is from 10,000,000 to 50,000,000 tons—a disparity in the estimates which indicates clearly the enormity of the deposit.

Furthermore, it is so near the surface of the ground that it has merely an overburden of earth and clay varying from two to ten feet in thickness, which easily can be removed by means of a gasoline shovel. In fact, that is the method employed by the present owners of the quarry. It is claimed that after passing the ore through the relatively simple processes at the quarry mill, the substance emerges in a state which tests to more than 95 per cent of pure sodium sulphate, and that it appears that here in Arizona nature has done in advance what men have been compelled to do by more or less laborious and costly processes in order to quarry, prepare and purify such deposits of this substance as have been found here and there in other sections of the country. It may be asserted that nowhere else in North America has there been found such a huge store of this material, so easily get-at-able and of such pristine purity as is this Arizona deposit.

As stated above the deposit was opened up a few years ago by the Western Chemicals, Inc. However, equipment at the quarry was rather crude and worked in a haphazard manner, resulting in only intermittent production. No difficulty was experienced, however, in disposing of its product among glass manufacturing concerns on the Pacific Coast and among certain of the pulp and paper mills in the south. Eventually, nevertheless, the company found itself involved in financial difficulties and was compelled to discontinue quarry operations. About this time R. W. Coad, who had taken a financial interest in the project under its first owners, visioning the immense possibilities of the quarry if it should be worked along scientific lines and that if a dependable merchandising policy could be established, organized a new company, capitalized at $400,000 and incorporated under the name of the Sodium Products Corporation. The stock of the old company was taken over and the work of reorganizing the enterprise was undertaken.

This was accomplished by speeding up every process from quarrying the ore to putting it into the shipping bins. Much new and improved machinery was required to accomplish this result. Probably the single greatest improvement made in this revamping of the mechanical equipment was in the washing plant. Originally the log washers were installed side by side, permitting of but one washing of the ore, but, under the new arrangement, the washers are placed in series, so that the ore is washed six times, thus more effectively removing clay and other impurities. This results in purifying the ore until it tests better than 95 per cent pure sodium sulphate. All of these improvements were completed about the middle of February, 1927.

After the overburden of earth and clay is removed from the ore, the deposit is drilled and dynamited. The fragments of the ore then are loaded into trucks and dumped into a storeage bin. From this bin the ore feeds into a 30" x 30" Jeffrey roll crusher and thence is carried on a conveyor belt to what is called the middle storage bin. From here the ore goes to a series of eight log washers, each 20 feet in length, in which it is washed six times. The ore then passes over two de-watering screens and goes into a rotary dryer, 50 feet in length, in which it is subjected to a heat of approximately 700 deg. F.

After leaving this dryer the ore feeds through a secondary crusher and emerges in small fragments, none of which measures more than one quarter inch in size. It then is elevated into the mill by means of a bucket conveyor and is graded by being passed over screens of differing mesh. The first grade, consisting of the one quarter inch fragments, is destined for the pulp and paper mills; the second grade, of minus 10 mesh, goes to manufacturers in the glass industry while the third grade, of minus 20 mesh, is taken by the manufacturers of stock remedies.

This deposit of sodium sulphate is of more than usual interest to the industries which use it for the reason that in its natural state the ore is anhydrous and is free from acid.

During the time when the quarry was being worked by its former owner, the relatively small output was absorbed readily by the two or three glass concerns mentioned and as many paper concerns. But under the new management, whereby an approximate production of 120 tons a day is reached, the distribution in both the glass and the paper industries is to be extended materially.

For the present the company intends to occupy itself with the production of sodium sulphate alone, leaving the development of the many by-products possible for the future.

Better Equipment for Box and Crate Shop

In modernizing existing glass factories and designing new plants, the importance of planning economical manufacturing methods for the box-making and crate departments, and putting the plans into practical effect by installing modern labor saving and waste-eliminating equipment, is often overshadowed by the supposedly more pressing requirements of the production departments. It appears that in some factories the box shop is considered as hardly worth bothering with as a field for possible improvements. A scientifically designed and equipped shop is the exception rather than the rule, throughout the industry.

It is worth while therefore to give attention to a new piece of time and labor saving and waste eliminating equipment that has already been adopted by a number of prominent manufacturers and jobbers, such as Graham Glass Company, American Bottle Company, Evansville Glass Company and others, and is showing a wide usefulness and substantial savings over hand methods in the cost of the work it does.

This device is the Onan Portable "Safty Saw." This saw was not designed and put on the market by its makers merely for the sake of having a saw to sell. On the contrary, it is the perfected form of the logical, gradual development of a single machine originally intended some years ago to meet the requirements of only one man, David W. Onan, who was a manufacturer of automotive electrical garage equipment.

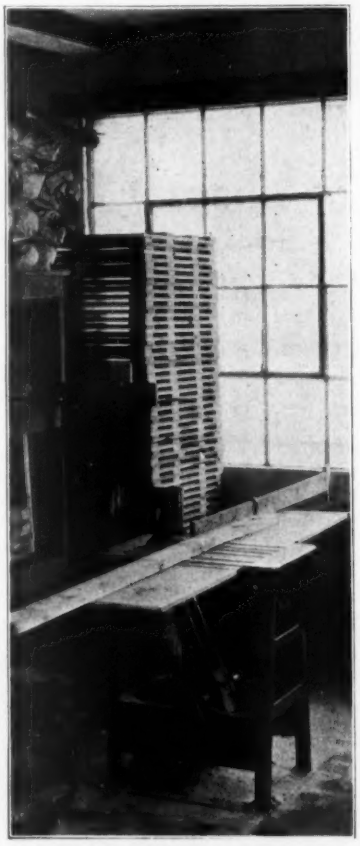
D. W. Onan & Sons, of Minneapolis, Minn., was even then, a successful, nationally known concern. Business was good, but a real fly in the ointment was in getting shipments crated on time. Mr. Onan studied the situation and found the trouble was all due to the different styles and kinds of crates used. Standardized crating and packing could not be accomplished.

Some of the equipment had to be crated where it was assembled and tested. Therefore, it required either an additional amount of space for a permanent saw in connection with the assembling department or a saw which could be moved about the plant, and put out of the way when not required.

Where the "shoe pinched worst" was that the factory was able to secure the order for its products, build and test the equipment, and then the delay caused by inability to get it crated and packed for shipment often dragged large amounts of business over to the next week or month. No complete schedule of production, so far as shipping was concerned, could be established.

Mr. Onan set about to find a saw that would meet the requirements. After thoroughly investigating the market, he found nothing particularly adapted for his case. Therefore, being of a mechanical turn of mind, he set about to design and build a saw for his particular job.

The saw was designed with the largest necessary cutting capacity for general crating, it was made light, safe, portable and inasmuch as it was to meet the requirement of only one user, inexpensive. In order that it might be put out of the way when not in use, it was arranged to run from the lighting circuit.



ONAN FORTABLE "SAFTY SAW"

Soon it was found that the use of this saw eliminated the old "grief" in shipping. A very interesting angle then developed. It was found that other departments began to "borrow" this saw. Being portable, it could be wheeled about the plant. For carpentry work, salvaging, and wherever a small amount of sawing had to be done, this equipment was used. It was no longer merely shipping room equipment.

At about this time other men who saw it in operation, or heard about it, began asking that one be built for them. This was done and soon Onan saws were humming merrily in factories, office buildings, jobbing houses and other concerns throughout Minneapolis and St. Paul.

The rest of the story is simply told. The possibilities of the saw were very apparent. The market was unlimited, the demand was increasing without any effort on the part of the manufacturer. The tail was wagging the dog. Advertising was sent out and what had started as a home-made time saving device became a nationally known and sold necessity. It was not long before a new and bigger factory was needed.

When used for crating, packing, box re-sizing, and utility work, such as shelf and bin building, carpentry work, millwright, construction, etc., around plants, it does away entirely with hand sawing. With its use, it is possible to save old crating material, salvage lumber for carpentry work, and in the glass industry, where it is necessary to make a good many different styles and kinds of boxes for shipping glass,—"Well," Mr. Onan says, "this saw is built particularly for that job."

BRANDS USED IN THE REFRACTORIES INDUSTRY. 7th edition, compiled by the American Refractories Association, Pittsburgh, Pa. An alphabetical list of approximately 600 brands of refractories produced by over 150 manufacturers whose names and addresses are listed by States and who operate over 800 plants in the United States and Canada.

The Glass World and What It Is Doing

News of the Industry

New Testing Furnace at Carnegie Tech

The equipment represented by the accompanying illustration was installed by the Carnegie Institute of Technology, Pittsburgh, to be used in connection with courses in heat and combustion engineering. During the school year 1926-1927, a course of this nature was given to graduate students, most of them being combustion engineers of the Pittsburgh district. The equipment will be used from now on in the new day course in Heat Engineering, which is given in the Mechanical Engineering Department by Professor W. Trinks.

The majority of mechanical engineers think of combustion with reference only to combustion in the boiler furnace, whereas the field is very much larger, since it refers alike to industrial furnaces used for heating and those used for melting and refining glass, metals and other substances.

The principal part of the set illustrated consists of an oblong furnace to which various kinds of burners and combustion devices can be attached at one end. It is provided with observation holes through which flue gas samples can be taken and through which temperatures of the flame and of the furnace walls can be observed. Above the rear end of the tunnel there is a "Calco" recuperator by means of which the combustion air can be preheated to about 800 deg. F. The piping and blast ducts are so arranged that the furnace can be supplied either with cold air or with hot air. In the former case the hot air goes directly to the stack so as to protect the recuperator from being burned out. A "Carborundum" recuperator with "core busters" is being installed at the side of the furnace. This recuperator is designed for preheating the air to a very high temperature.

Instruments have been provided for measuring temperatures and for analyzing fuel as well as flue gases. All fuel and air quantities are being measured.

At the present time natural gas serves as fuel but pumping and heating equipment is on the ground for using oil and tar as fuel and is now being installed. The Mechanical Laboratory also has a gas producer so that studies can be made with producer gas. Arrangements are furthermore being made to remove the "snout" or flared section which lies between the burner proper and the combustion tunnel and which is plainly visible at the right hand end of the picture and to replace it either by ports of high temperature furnaces or else by grates and stokers for the purpose of studying the combustion of coal and of the gases rising from the fuel bed.

COMBUSTION TUNNEL IN THE DEPARTMENT OF MECHANICAL ENGINEERING, CARNEGIE INSTITUTE OF TECHNOLOGY

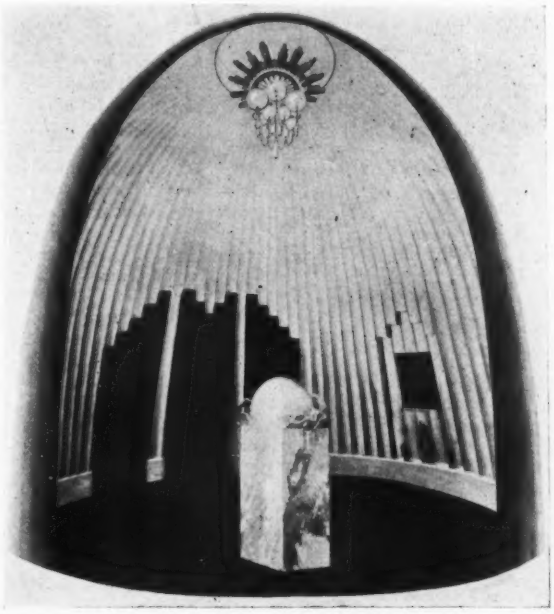
It is believed that this is the only combustion tunnel installed in any university or college in the United States.

It should be particularly useful for testing the capacity of oil burners under different conditions and for similar work.

The "Celestialite" Exhibit

Through the courtesy of R. B. Cressman, of the Gleason-Tiebout Glass Company, New York, the accompanying sectional illustration of their exhibit which attracted great attention at the recent Architectural Exposition in New York, and which was referred to in the April issue, has been made available, permitting the observer to visualize, at least faintly, the simple beauty and originality of the design.

The dimensions and outline of the dome-shaped booth proscribed the obtaining of a photograph that would begin to do justice to this unusual method of displaying lighting fixtures. The effect of purity and brilliance produced in the beautifully proportioned interior by illumination from the fine "Celestialite" fixture at the top of the dome, was novel and artistic and can hardly be imagined by anyone who did not see it.



"CELESTIALITE" EXHIBIT AT ARCHITECTURAL EXPOSITION

The inspiration that resulted in this innovation in glassware exhibition methods came to its creator, Howard Greenly, the well known architect and interior decorator, from the Gleason-Tiebout slogan "Celestialite—is next to Daylight." What he did was effectively described by a writer in *The Pottery Glass & Brass Salesman:*

"He built a booth representing a high-domed interior, done entirely in a Celestial blue to give the effect of the heavens, with fleeting clouds here and there. Suspended from the center of the dome was a sunray of glass manufactured by the concern. Just underneath this were Celestialite units and tubes, the whole making a very handsome and unusually striking fixture. Right in the center of the floor, on a large pedestal, was an immense glass ball, made by Gleason-Tiebout, decorated with the map of the world, and suggesting the earth. The floor was done in dead black. The thought this arrangement conveyed was that Celestialite in the heavens was illuminating the earth, in all darkness, below. There was charm not only in the very simplicity of the idea, but in the great care bestowed upon every detail in working it out. The effect was not marred but rather added to by three niches in the walls, resembling to an extent Gothic church windows. In each niche was set a piece, or two pieces, of Celestialite glass to show the types of ware made by the concern.

Reports New Glass with Remarkable Properties

According to W. F. Kohler, who has just arrived in New York after a long visit in Europe, a formula has been developed for a new heat, pressure and acid resisting glass that survives the test of being heated to 210 degrees Celsius in an oil bath, then immediately plunged into water at zero temperature, and that when tested in a gauge withstood a pressure of 170 atmospheres which blew out the packing without breaking the glass. Mr. Kohler also states that the glass resists any acid that may be applied to it, and that he is in control of the formula and the process of producing the glass in all territory outside of Europe, including the United States and Canada.

Standards Yearbook 1927

The Standards Yearbook represents an effort to present an adequate picture of the diversification and ramification of the standardization movement which has spread throughout the world with astonishing vitality during the 25 years that have elapsed since the establishment of the National Bureau of Standards. It contains outlines of the activities and accomplishments of not only this bureau and other agencies of the Federal Government and the states and municipalities but also of the American societies and associations of which standardization is a major or very important activity. Descriptions and illustrations are presented of all the fundamental national standards of the United States. Moreover, outlines are given of the various foreign national and the several international standardizing agencies.

As a companion volume to Commerce Yearbook, which deals strictly with industry and commerce, the Standards Yearbook deals strictly with standards and standardization. In one volume are correlated the essentials concerning standardization activities with which the Bureau of Standards is in close co-operation, and the subject of standardization is presented in its entirety.

In a general review of the standardization movement in America attention is directed to the remarkable growth in the activities of the trade associations, the development of "mass-production" method of factory production and to the vital interest now being shown in standardization by industrial executives. Noteworthy in the trend in the development of standards is the process based on the elimination of excess varieties and sizes which is supplementary to the slower process involving technical consideration. A development of no little importance is the substitution of performance, of service, requirements for composition specifications in certain lines of manufacture.

The Standards Yearbook is being issued as Bureau of Standards Miscellaneous Publications No. 77, and can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at $1.00 per copy.

New Course in Fuel Engineering

The Towne Scientific School of the University of Pennsylvania is announcing a new one-year course in fuel engineering, opening September 30, 1927. The course leads to the degree of Master of Science in Fuel Engineering. It embraces fuel resources; mining methods: preparation for market, distribution, storage and rehandling; composition and combustion of fuels; manufacture of special fuels; uses of fuels and specifications for purchase; furnaces, fuel sampling, analysis and calorimetry, fuel testing in heating and power appliances, domestic heating, cooking, smoke elimination, regulations affecting use of water power and fuel resources, research, and electives. The director of the course in fuel engineering is Robert H. Fernald, M. E., Ph.D., Sc.D. A booklet giving information regarding the course is available.

New Glass Plant for the Ukraine

F. A. Rataichak, president of the Porcelain and Glass Trust of the Ukraine, has left the United States after a stay of over a month, in the course of which arrangements were made with American firms regarding the construction of a $3,000,000 glass plant at Kiev, in the Ukraine. The arrangement was recently announced by the Amtorg Trading Corporation, 165 Broadway, New York. J. B. Seldes, another member of the Glass Trust delegation, sailed with Mr. Rataichak, while F. S. Kariagin was left behind to complete the arrangements.

An American firm has been asked to prepare plans for the equipment of the Kiev plant. American production methods, which the delegation had a chance to study in 30 plants through the courtesy of leading firms in the glass and ceramic industries, were much admired.

The equipment of the Kiev plant will cost over $2,600,000, of which $1,200,000 worth will be purchased from American firms, with deliveries beginning next July. The Kiev plant will have an output of 22,000 metric tons of assorted glass per year.

Production of glass in the Soviet Union in 1920 fell to less than 4 per cent of pre-war production. At present the output is higher than before the war. The industry increased its output 60 per cent last year, and further increase of 30 per cent is expected during 1927.

Glass Division, American Ceramic Society

The personnel, officers and appointments of the Glass Division, American Ceramic Society, for the current year are as follows:

CHAIRMAN, H. L. Dixon, H. L. Dixon Company, Pittsburgh, Pa.; VICE CHAIRMAN, C. D. Spencer, General Electric Company, Cleveland, O.; SECRETARY, A. N. Finn, Bureau of Standards, Washington, D. C.

COMMITTEES:

Research: E. W. Tillotson, Mellon Institute, Pittsburgh, Pa.

Standards: A. R. Payne, Fostoria Glass Company, Moundsville, W. Va.
F. C. Flint, Hazel-Atlas Glass Company, Washington, Pa.
D. D. Schurtz, Sharp-Schurtz Company, Lancaster, O.
H. H. Blau, Macbeth-Evans Glass Company, Charleroi, Pa.
C. E. F. Lundell, Bureau of Standards, Washington, D. C.

Data: Chas. O. Grafton, Gill Clay Pot Co., Muncie, Ind.
J. T. Littleton, Corning Glass Works, Corning, N. Y.
E. J. Casselman. Mellon Institute, Pittsburgh, Pa.

Membership: A. W. Kimes, *National Glass Budget*, Pittsburgh, Pa.
J. B. Krak, THE GLASS INDUSTRY, New York, N. Y.

Rules: A. E. Williams, Hartford Empire Co., Hartford, Conn.

Education: A.Silverman, University of Pittsburgh, Pittsburgh, Pa.

Nomination: A. E. Williams, Hartford Empire Co., Hartford, Conn.
F. C. Flint, Hazel-Atlas Glass Co., Washington, Pa.

Papers and Program: C. D. Spencer, General Electric Co., Cleveland, O.

Trustee: J. C. Hostetter, Corning Glass Works, Central Falls, R. I.

Simplification Reduces Costs of Bulbs

In the April issue of the *Monthly News Bulletin* of the Division of Simplified Practice, Department of Commerce, Washington, D. C., credit is given to simplification for the recent reduction in prices of Mazda incandescent lamps effective April 1, which was made possible by the abandoning of about forty-five types of lamps and the universal acceptance of the six new types of inside frosted bulbs. The old type of outside frosted lamps, which absorbed approximately 20 per cent of the light and collected considerable dust and dirt with their rough surfaces, sold for approximately three times as much as the new inside frosted lamp. This is the third reduction in prices since the new inside-frosted lamps were introduced in 1926. The reduction lowers the prices of 25 and 40 watt lamps to 23 cents each, the 50 and 60 watt sizes to 25 cents each, and the average price of all Mazda lamps to 49.4 per cent less than in 1914.

Duty Increase on Bottles Requested

An appeal was made to President Coolidge on April 30 by James Maloney, president of the Glass Bottle Blowers' Association of United States and Canada, that the United States Tariff Commission continue and complete the investigation of conditions in the glass bottle industry which was started in 1925 but which has not been pursued to a conclusion because

of lack of funds. Mr. Maloney pointed out that because of changes brought about by the increasing use of automatic bottle making machinery only four important hand blowing bottle plants have survived, two in Baltimore, one in Millville, N. J., and another in Chicago Heights. Mr. Maloney stated that it would be unfortunate to have this skilled branch of the industry disappear, because of its being essential in time of war. In 1925, when the request for action was made it was declared that the industry could not continue to exist under the protective tariff of 55 per cent ad valorem and an increase was therefore requested.

Graham Brothers Offer Co-operation

Graham Brothers Corporation, Detroit, Mich., who were instrumental in the organization of the Libbey-Owens Security Company which recently purchased holdings in the Libbey-Owens Sheet Glass Company from the Edward D. Libbey Estate, have announced that they have established at 1 East 44th Street, New York, a financial organization of broad scope already operating in the industrial field and participating extensively in the ownership of industrial enterprises. The organization has at its command the resources for investment in manufacturing organizations engaged in varied lines. One of the members, J. B. Graham of Detroit, was recently elected a director of the Libbey-Owens Sheet Glass Company, to take the place of Potter Palmer of Chicago, who as announced in the May issue, retired and was elected a director of the Libbey-Owens Security Corporation.

Annual Exposition of Chemical Industries at Essen

The fifth annual exposition of chemical equipment, organized by the "Achema" (Austellung für Chemisches Apparatewesen) will be held simultaneously with the annual meeting of the Association of German Chemists, in the city of Essen, from June 7 to 19. Five large halls will be at the disposal of more than 200 of the leading firms, manufacturing chemical apparatus and equipment, machinery and auxiliary appliances.

For the purpose of advertising the exhibition, the "Achema" has published the "Achema" Yearbook, containing a number of highly interesting articles, relating to the various phases of the German chemical industries. Introductory articles have been contributed by a number of the leading German chemists and manufacturers, making the yearbook of unusual value. Copies can be obtained from the publishers, at the main office of the "Achema," located in Seelze, Hannover, Germany.

Milk Bottle Companies Merge

Formal announcement of the merger of the Berney-Bond Glass Company, Clarion, Pa., and The Winslow Glass Company, Columbus, O., was issued about May 1. The two well known concerns have joined forces to the end that they may occupy a wider field of usefulness. The merger will give the customers of both organizations the benefit of the experience of both engineering departments which will be united to incorporate in future products the best features of both makes of bottles.

Quicker delivery will be possible due to increased manufacturing capacity and to factories strategically located in different sections, resulting in shorter hauls and quicker delivery. The new organization will have five complete manufacturing units, two at Clarion, Pa., two at Columbus, O., and one at Hazel Hurst, Pa.

May Meeting of Pittsburgh Section

Donald W. Ross, Findlay Clay Pot Company, Washington, Pa., gave an illustrated talk on the manufacture and failures of glass tank block refractories and the research that is being done to better their service, at the regular meeting of the Pittsburgh Section of the American Ceramic Society on May 17. Ross C. Purdy, secretary of the Society, addressed the meeting on the purpose and progress of the proposed Ceramic Institute and Research Council.

To Investigate Tariff on Sodium Fluosilicate

The United States Tariff Commission will hold a public hearing on June 20 to determine whether import duties should be changed on sodium fluosilicate, or sodium silico fluoride. This product is said to be used chiefly in the laundry business but a substantial amount is also used in glass making.

John Kunzler Honored

At a meeting of the National Association of Manufacturers of Pressed and Blown Glassware held at Pittsburgh on May 3 the members of the organization presented to John Kunzler, secretary, who has retained that position for the past 25 years, a silver service set in appreciation of his loyalty and unfailing interest in the welfare of the association. Another matter which was discussed at the meeting was the proposed changes in wage agreements to be taken up with the workers' union at the joint conference which will take place at Atlantic City early in July.

Sand Producers Merger in Doubt

Negotiations regarding the rumored combination of eastern glass sand producers which has been mentioned in the daily press and discussed to some extent in the trade during the past several months, have not, it is reported, been concluded and it is not definitely known whether or when the project will be carried out.

Plate Glass Production in April

The production of polished plate glass reported by P. A. Hughes, secretary of the Plate Glass Manufacturers Association, for the month of April, 1927, was 10,299,476 sq. ft., as compared with 11,641,036 sq. ft. produced during the month of March. The production of April, 1927, is about 500,000 sq. ft. less than that of April 1926, when 10,725,766 sq. ft. was produced.

Trade Activities

The Drehobl Bros. Art Glass Company is erecting what is stated to be the biggest art glass manufacturing plant in Chicago, at 2847 Lincoln avenue.

The Gill Glass Company, Philadelphia, Pa., are having plans prepared for a 2-story and basement addition, 150 by 250 feet, to its plant at Amber and Venango Streets, at an estimated cost of $200,000.

The Michigan Alkali Company, New York, N. Y., through J. B. Ford, president, announces the appointment of Irving M. Taylor as director of sales to succeed Eugene M. Taylor, who has resigned owing to continued ill health.

The Brockway Machine Bottle Company, Brockway, Pa., have had plans prepared for a one-story addition, 7 x 125 feet and 50 x 75 feet, to cost more than $70,000. The H. L. Dixon Company, Pittsburgh, Pa., are the engineers.

The Armstrong Cork & Insulation Company, Pittsburgh, Pa., announces that its branch office in New York City is now located at 225 Broadway, and the Tulsa, Okla., office is now located at 419 Central National Bank Building.

Ohio Window Glass Company, J. Unger, manager, 4045 St. Clair avenue, Cleveland, O., has awarded contract for the construction of a 2 story, 37 x 75 ft. plant to R. Hansen Construction Company, Cleveland. The estimated cost is $40,000.

The Hazel-Atlas Glass Company, Wheeling, W. Va., report for the first quarter of 1927 showed net earnings of $986,532, after deducting $212,549 for repairs, maintenance, etc. This is one of the best quarterly reports so far issued by the company.

The Adamston Flat Glass Company, Clarksburg, W. Va., is reported to have broken ground for a new factory adjoining the present plant, to be equipped with sheet glass drawing machines. It is expected that the new factory will be ready for operation by the first of September.

Owens Bottle Company, Toledo, reported at the annual meeting on April 20, earnings for the first quarter of 1927 as $1,119,117, after taxes, depreciation and other charges are deducted. Net profit for 1926 was $6,928,656 and $4,043,686 was distributed in dividends to share holders.

The Kolux Glass Sales Company, 211 West Superior Street, Kokomo, Ind., has been incorporated with a capital stock of $40,000 to sell and buy electric signs and glass. The incorporators are: William S. Hough and M. Charlotte Hough of Kokomo, and Walter Meacher of Toronto, Canada.

The Bethel Engineering Company, Huntington Park, Cal., recently contracted with a West Coast milk bottle factory, which is being completely remodeled, enlarged and equipped with new furnaces, to furnish the latest type of Bethel feeders and Miller Machine & Mold Works new motor driven milk bottle machines.

Semon Bache & Company, New York, announce that they have acquired the business of Jacques Kahn, Inc., also of New York, and that the business of the consolidated companies will be conducted from their present plant at Greenwich & Morton Streets, New York. Both concerns are large importers and distributors of glass.

The Glass Decorating Corporation, Baltimore, Md., recently incorporated, has purchased the entire plant and equipment of the Pyrograph Advertising Sign Corporation at Eastern Avenue and 37th Street, Baltimore. The principal products of the company will be glass signs for service stations and a wide variety of flat and special-shaped glasses for inserts in electric signs, and also novelties.

The Binney Castings Company, 1805 Clinton Street, Toledo, O., is preparing to market their special "non-scaling" bronze for glass molds. This is a non-ferrous alloy which has been carefully developed and thoroughly tested in actual operation. Its manufacture will be under laboratory supervision with experienced operators in charge of the foundry. A new gear metal will also be produced.

The Clarksburg Flat Glass Company plant at Clarksburg, W. Va., was reported sold at a trustee's sale on May 7 to the Harrison Investment Company of Clarksburg. The plant, which was formerly the American Sheet Glass Company, has been closed down for some time and the officials of the investment company announce that no plans are under way at present to resume operations.

The Blue Ridge Glass Corporation, Kingsport, Tenn., is completing its equipment and it is understood that manufacturing operations will begin within a few weeks. It is understood that machinery for making rough and polished wire glass by a continuous process is being installed and that other products will be rough rolled and hammered glass, ornamental and figured glass in many designs.

The Citizens Glass Company, Barnesville, Pa., is reported to have been reorganized by the incorporation of the company under the laws of Delaware. The following men are reported as directors: Judson Ballard, E. C. Stewart and Gibson Bradfield, of Barnesville; Louis Mottet of Cedar Grove, La., and Donald Cruikshank and Dean Paul of Cleveland, and Jules Biron, who will also remain as manager.

The Phoenix Glass Company, Pittsburgh, Pa., according to press reports, recently lost an appeal to the United States board of tax appeals to avoid paying more than $30,000 in income and profit taxes for 1920 and 1922. The tax board ruled that 8 per cent allowed by the commissioner of internal revenue for depreciation on equipment and machinery was reasonable and held that the Phoenix Company did not introduce evidence to substantiate a 12½ per cent allowance.

The Austin Company, engineers and builders, Cleveland, O., have opened a branch office in Cincinnati in the Dixie Terminal Building, making a total of thirteen branch offices throughout the country. H. L. Cornelison, until recently manager of the Miami office, has been placed in charge on territory covered by the Cincinnati office including southern Ohio, southern Indiana and Kentucky. Over 200 industrial projects have been built by Austin in the Ohio Valley during the past five years. The Chicago headquarters of the Company have also been moved to larger quarters at 510 North Dearborn Street.

The Interstate Window Glass Company's property, which has been in the hands of a receiver for the past two years, was sold at a recent public sale to J. B. Angloch, of Kane, Pa., for $650,000 by L. C. Crile, of Clarksburg, W. Va., who acted as agent for the reorganization committee of the company. The sale included factories at Smethport, Mt. Jewett, Pa., Huntington, W. Va., Weston, W. Va., two plants at Kane, Pa., and two at Clarksburg, W. Va. A plant at Okmulgee, Okla., was also recently sold to F. J. Andrews, general superintendent of the company.

Personals

Roy A. Blunt has become connected with the Buck Glass Company, Baltimore, Md., as general manager. His former connection was with the Corning Glass Works.

George P. MacNichol, Jr., has succeeded J. Roy Helm, who recently resigned, as treasurer and sales manager of the Edward Ford Plate Glass Company, Rossford, O.

Fred W. Schroeder, formerly with the United States Bureau of Mines at the Tucson, Arizona, Station, is now with the refractories division of the Corning Glass Works, Corning, N. Y.

W. R. Crawford has become associated with the Blue Ridge Glass Corporation, Kingsport, Tenn., as sales representative. Mr. Crawford previous to the past year had been connected with the sales department of the Pittsburgh Plate Glass Company.

James L. O'Neill, formerly official of the Carnegie Steel Company, and at present vice-president of the Guaranty Trust Company of New York, has been appointed a director of the Hazel-Atlas Glass Company, Clarksburg, W. Va., to succeed the late J. J. Holloway.

Charles DeFlaudre, factory superintendent of the Crystalleries de Nancy, Nancy, France, is making a tour of some of the principal glass centers of this country to study mechanical glass-making methods. The plant at Nancy is at present operated by hand methods, but a change to machine methods is being considered. Mr. De Flaudre's headquarters while in this country are at the offices of the French-American Glass Company, 130 Bleecker Street, New York.

Recent Deaths

Palmer Winslow

Palmer Winslow, founder and former president of the Winslow Glass Company, Columbus, O., died at his home in that city on April 25. Mr. Winslow was born in Fairmount, Ind., in 1876 and was educated in the public schools there, the Fairmount Academy and the Quincy, Ill., Business College. At the age of 18 he took charge of the Fairmount Glass Company on the death of his father, later disposing of these interests, and in 1898 organized the Winslow Glass Company, at Matthews, Ind. In 1904 he established a branch factory at Columbus, and later removed the original factory from Matthews to Columbus. Mr. Winslow was part owner of the Boston Baseball Club of the American League. He is survived by his wife, daughter, a brother, Philip K. Winslow, present president of the Winslow Glass Company, and four sisters.

S. O. Richardson, Jr.

S. O. Richardson, Jr., aged 63, for nearly 40 years a leader in the glass industry in Toledo, died at his summer home near Grayling, Mich., on May 1. Mr. Richardson was born in Wakefield, Mass., and in 1881 entered the employ of the New England Glass Company, Cambridge. In 1888 he accompanied E. D. Libbey in the removal of the New England Company to Toledo, which later became known as the Libbey Glass Company. He was at one time vice-president and president of the Libbey Company. He is survived by his wife, two sons, S. O. Richardson, III, and A. B. Richardson, and a daughter.

Homer Brooke

Homer Brooke, of Mt. Vernon, N. Y., inventor of the famous Brooke glass feeding device, died early in May at Richmond, Va., where he was taken ill while returning from the south where he had spent the winter with Mrs. Brooke. He was 85 years of age. After his early efforts to induce the trade to accept his inventions became successful they proved of great benefit to the industry, greatly aiding in the increase of production and reduction of the costs of glass products.

dustrial Publications

Pyrometer . .ruction. Bulletin No. 358. The Bristol Company, Waterbury, Conn. A guide for users of thermo electrical pyrometers for the securing of the greatest efficiency and satisfaction. Discussions of pyrometer parts, principles of operation, hot and cold ends of thermo-couples, extension leads, calibrated extensions, electrical connections, switches, fire-ends, selecting location, cause and remedies of pryometer troubles, checking equipment and other subjects are included. It also contains carefully prepared instruments and advice for proper operation of the instruments.

Coming Meetings

THE STAINED GLASS ASSOCIATION will hold its twenty-seventh annual meeting at St. Louis, Mo., on June 27, 28 and 29.

THE AMERICAN FLINT GLASS WORKERS' UNION will hold its annual convention at Cambridge, O., on July 4.

THE AMERICAN BOTTLERS OF CARBONATED BEVERAGES annual convention will be at New Orleans, La., November 14 to 18, 1927.

THE NATIONAL GIFT AND ART ASSOCIATION will hold its fall exhibition at the Hotel Adelphia, Philadelphia, Pa., August 22 to 27.

THE AMERICAN CERAMIC SOCIETY'S next annual meeting will be held at the Ambassador Hotel, Atlantic City, N. J., February 5 to 11, 1928.

THE EASTERN DIVISION, NATIONAL GLASS DISTRIBUTORS ASSOCIATION, will meet at 10:30 a. m. on Wednesday, June 15, at the Hotel McAlpin, New York.

THE NATIONAL ASSOCIATION OF MANUFACTURERS OF PRESSED AND BLOWN GLASSWARE will hold a meeting at the Marlborough-Blenheim Hotel, Atlantic City, on Monday, July 18, and the AMERICAN ASSOCIATION OF FLINT AND LIME GLASS MANUFACTURERS will meet Monday afternoon, July 18, at the same place. The annual wage conference between the members of the National Association of Manufacturers of Pressed and Blown Glassware and the wage committee of the AMERICAN FLINT GLASS WORKERS' UNION will begin at the Marlborough-Blenheim on July 21.

Glass Stock Quotations

PITTSBURGH STOCK EXCHANGE, MAY 22, 1927

Reported by Moore, Leonard & Lynch, Union Trust Bldg., Pittsburgh, Pa

	Bid	Asked	Last
American Window Glass Machine, Com.	...	40	38
American Window Glass Machine, pfd.	68	...	70
American Window Glass, pfd.	...	...	103
United States Glass	13	14¼	13
Pittsburgh Plate Glass, com.	230	240	230
Standard Plate Glass, com.	3	3⅛	3⅛
Standard Plate Glass:			
Preferred cumulative	10	...	11
Prior preferred	35	...	35⅛

TOLEDO STOCK EXCHANGE, MAY 25, 1927

	Bid	Asked	Last
Owens Bottle Machine, com.	118	118½	118¾
Libbey-Owens Sheet Glass, com.	123	125	124
Libbey-Owens Sheet Glass, pfd.	115	...	118

WHEELING STOCK EXCHANGE, MAY 25, 1927

	Bid	Asked	Last
Hazel-Atlas	53	53½	53½
Imperial	..	40	72
Fostoria	175	..	208
Central	..	75	75

Inquiries Received

For further information address THE GLASS INDUSTRY

373. We have an inquiry from our connections in South Africa for "shop rounds" (bottles) for dispensaries. Can you give us the names of a few manufacturers? (May 17).

374. Can you refer us to any reputable dealers for glass cutter's supplies, such as ferrules, guides, rules, etc? (May 9).

375. Can you tell me where I can get in touch with some manufacturer of glass paper weights with photographs in them, or manufacturers of plain paper weights and glass novelties? (May 11).

What The World Wants

Specific Inquiries for American Goods Received in the Department of Commerce, Washington, D. C.

Spain: 25301, glass-making machinery.

Germany: 25444, glass bottles for medicine; 25571, Glass-decorating kilns, grinding and mixing mills, and spraying and blowing machines.

England: 25440, glass pots, with glass lids and aluminum screw caps, for creams; and perfume bottles, frosted and cut.

Australia: 25594, colored glass in sheets.

READERS WANTS AND OFFERS

Positions Open

Wanted—Young man with engineering or operating experience in glass manufacturing plants, to sell, install and service electric pyrometers, recording instruments and automatic temperature control equipment for use in the glass industry. Candidates must be free for quick transfers and unlimited travelling throughout the United States. Highest character references required. Young single man preferred. Write stating age, education, experience and salary desired. Address Salesman, care THE GLASS INDUSTRY, 50 Church Street, New York.

Experienced Glass Man—We would like to obtain the name of an experienced glass man with thorough knowledge of the proper mixing and melting of actinic glass, which permits ultra violet rays to pass through. Address, ULTRA VIOLET, care THE GLASS INDUSTRY, 50 Church Street, New York.

Positions Wanted

Factory Superintendent. Belgian, superintendent of a window glass factory using the Fourcault process, with long experience in the construction and management of furnaces and machines, desires a similar position in a mechanical window glass factory in the United States. Address, A. B. C., care THE GLASS INDUSTRY, 50 Church Street, New York.

Glass Chemist, with ten years' experience in both laboratory and plant, desires position where full responsibility can be assumed. Fully qualified to produce flint or colored glasses in pots or tanks, suitable for machine or hand operation. Address, Chemist, care of THE GLASS INDUSTRY, 50 Church St., New York.

Used Machinery

For Sale: 3 Gas producers, 500 H.P. each; 1—Williams No. 5 Roller Knife Crusher; 2—300 H.P. Ball Erie, rope drive, engines, American system. Excellent condition. Write for particulars. Address, Box No. 5, care THE GLASS INDUSTRY, 50 Church Street, New York.

Current Prices of Glass-Making Materials

May 24, 1927

Quotations furnished by various producers, manufacturers and dealers.

		Carlots	Less Carlots
Acid			
Citric (dom.)	lb.	.43½–.44½	.43½–.44½
Hydrochloric (HCl) 20° tanks, per 100 lb.	lb.	..	.95–1.05
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.13½
52% and 48%	lb.	.10	.10–.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	5.75
Sulphuric (H_2SO_4) 66° tank cars	ton	15.00-16.00	..
Tartaric	lb.	.35	.35
Alcohol, denatured	gal.	..	.40½
Aluminum hydrate (Al $(OH)_3$)	lb.	.04½–.05	.05–.05½
Aluminum oxide (Al_2O_3)	lb.	..	.07
Ammonium bifluoride (NH_4) FHF	lb.	..	.21–.22
Ammonia water (NH_4OH) 26° drums	lb.	..	.03
Antimony, metallic (Sb)	lb.	..	.14
Antimony oxide (Sb_2O_3)	lb.	..	.16½
Antimony sulphide (Sb_2S_3)	lb.	.14	.15
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.03¾	.04
Barium carbonate ($BaCO_3$)			
Precipitated	ton	53.00	58.00
Natural, powdered, imported	ton	48.00	50.00
Barium hydrate ($Ba(OH)_2$)	lb.	..	..
Barium nitrate ($Ba(NO_3)_2$)	lb.	.07½	.08¼
Barium selenite ($BaSeO_3$)	lb.	..	..
Bone ash	lb.	.05	.05½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	.04	.04¼–.04⅝
Boric acid (H_3BO_3)	lb.	..	.08–.09
Refined	lb.	.08–.09½	.08½–.10¾
Cadmium sulphide (CdS)—			
Red	lb.	..	1.20
Orange	lb.	..	1.00–1.25
Yellow	lb.	..	1.20–1.40
Chromium oxide (Cr_2O_3)	lb.	.27	.28
Cobalt oxide (Co_2O_3)			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide			
Red (Cu_2O)	lb.	..	.30
Black (CuO)	lb.	..	.25–.30
Black prepared	lb.	..	.30
Cryolite ($Na_3Al F_6$) Natural Greenland			
Kryolith)	lb.	..	.09¼–.09½
Artificial or Chemical	lb.	..	.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb.		1.10–1.20	1.30
Feldspar—			
100 mesh	ton	11.00-20.00	16.00-22.00
80 mesh	ton	13.50	..
40 mesh	ton	12.50	13.50
Fluorspar (CaF_2) domestic, ground, 95–98% (max SiO_2 2½%)			
Bulk, carloads, f.o.b. mines	ton	32.50	..
In bags or barrels	ton	36.50	41.50
Formaldehyde	lb.	.11¼	.11¾
Graphite (C)	lb.	..	.04–.07
Iron oxide—			
Red (Fe_2O_3)	lb.	..	.02–.03
Black (FeO)	lb.	..	..
Kaolin (f.o.b. mine)	ton	10.00	..
English, lump, f.o.b. New York	ton	13.00-23.00	..
Kryolith (see Cryolite)			
Lead chromate ($PbCrO_4$)	lb.	..	..
Lead oxide (Pb_3O_4) (red lead)	lb.	.10	.10¼
Litharge (PbO)	lb.	.09	.09¼
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	12.50	..
Burnt (CaO) ground, in bulk	ton	9.00	..
Burnt, ground, in paper sacks	ton	11.00	..
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.15	2.30
Limestone ($CaCO_3$)		2.00	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.04	.04½
light (in bbls.)	lb.	.22	.24
extra light (in bbls.)	lb.	..	.37
Magnesium carbonate ($MgCO_3$)	lb.	.06	.08½
Manganese 85% (MnO_2)	lb.	.04½	.05
Nickel oxide (Ni_2O_3), black—for nickel content	lb.	..	.35
Nickel monoxide (NiO), green—for nickel content	lb.	..	.35
Plaster of Paris, bags	ton	..	19.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.08¼	.08⅝
Ground	lb.	.11	.12
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.06¾	.07
Hydrated 80-85%	lb.	.06	.06½
Potassium chromate (K_2CrO_4)	lb.	..	.27
Potassium hydrate (KOH) (caustic potash)	lb.	.07½	.08
Potassium nitrate (KNO_3) (gran.)	lb.	.05½–.06	.06⅛–.06¼
Potassium permanganate ($KMnO_4$)	lb.	.12½–.13½	.14½
Powdered blue	lb.	..	.24–.26
Rochelle salts, bbls.	lb.	..	.22
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	22.00	..
Selenium (Se)	lb.	..	2.10-2.15
Silver nitrate ($AgNO_3$)	oz.	..	.41
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, on contract	Flat per 100 lb.	1.22½–1.27½	..
In barrels	Per 100 lb.	1.55–1.57½	2.40
In bags	Per 100 lb.	1.37½	..
Spot orders	.05 per 100 lbs. higher		
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06¼	.06¾
Sodium hydrate (NaOH) (caustic soda)	Per 100 lb.	..	3.50
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03⅞	.04⅛
95 per cent	Per 100 lb.	2.60	2.85
Sodium selenite (Na_2SeO_3)	lb.	..	2.35
Sodium fluosilicate (Na_2SiF_6)	lb.	.05	.05½
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.25
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.45	3.80-4.00
Flowers, in bags	Per 100 lb.	3.10	3.45-3.65
Flour, heavy in bbls.	Per 100 lb.	2.85	3.20-3.40
Tin chloride ($SnCl_2$) (crystals)	lb.	..	.47
Tin oxide (SnO_2) in bbls.	lb.	..	.70
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots	lb.	..	1.25-2.25
Zinc oxide (ZnO)	lb.	.06½	.07

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to April 23, 1927

	March 1926 Quantity	March 1926 Value	March 1927 Quantity	March 1927 Value	Three Months Ending March 1926 Quantity	Three Months Ending March 1926 Value	Three Months Ending March 1927 Quantity	Three Months Ending March 1927 Value
Glass and glass products (total)	.....	$756,567	.....	$802,105	.....	$2,089,899	.....	$2,125,779
Plate and window glass—								
Window glass, common, box 50 sq. ft.	2,459	13,903	864	6,490	11,059	55,283	3,871	25,060
Plate glass, unsilvered, sq. ft.	128,767	32,893	111,331	29,652	453,022	92,113	357,214	93,341
Other window and plate glass lbs.	177,214	14,391	372,352	28,468	494,679	48,288	1,013,963	83,648
Glass containers (bottles, vials and jars)	.....	244,581	.....	288,827	.....	658,208	.....	676,132
Table glassware, plain	.....	137,859	.....	153,258	.....	360,798	.....	374,229
Table and other glassware, cut or engraved	.....	11,444	.....	9,888	.....	34,287	.....	30,042
Lamp chimneys and lantern globes lbs.	168,650	32,087	154,184	32,439	589,033	108,951	547,525	115,437
Globes and shades for lighting fixtures lbs.	146,060	46,430	126,528	53,301	429,518	137,868	409,770	155,762
Chemical glassware lbs.	19,962	21,869	12,534	11,244	59,145	56,092	37,153	35,287
Electrical glassware, except for lighting lbs.	290,741	38,115	226,369	16,839	1,350,534	118,171	654,494	65,063
Other glassware	.....	162,995	.....	171,699	.....	419,840	.....	471,778

IMPORTS

Corrected to April 23, 1927

Glass and glass products	.....	1,781,666	.....	1,507,598	.....	4,543,208	.....	4,164,438
Cylinder, crown and sheet—								
Unpolished dut. lb.	5,699,013	295,729	.....	.....	15,819,667	718,200	.....	.....
Weighing less than 80 pounds per case dut. lb.	.....	.....	4,295,734	116,208	.....	.....	12,080,277	323,171
Weighing 80 pounds or over per case dut. lb.	.....	.....	3,788,364	148,466	.....	.....	10,765,857	517,060
Bent, ground, beveled, colored, painted, etc., and polished dut.	.....	40,620	.....	39,923	.....	134,768	.....	112,327
Plate glass dut. sq. ft.	2,376,239	773,509	.....	.....	6,185,099	2,001,726	.....	.....
Polished, unsilvered dut. sq. ft.	.....	.....	1,740,084	512,745	.....	.....	4,128,136	1,375,147
Other plate glass dut. sq. ft.	.....	.....	85,810	24,114	.....	.....	265,079	68,217
Containers—bottles, vials, etc. dut.	.....	28,670	.....	17,872	.....	75,343	.....	55,474
Table and kitchen utensils dut.	.....	6,967	.....	7,436	.....	13,852	.....	32,742
Glassware, cut or decorated dut.	.....	225,241	.....	301,149	.....	563,132	.....	795,541
Blown glassware, n. e. s.—								
Bottles, ornaments, etc. dut.	.....	91,075	.....	61,909	.....	208,654	.....	176,136
Bulbs for electric lamps dut.	1,505,527	24,041	1,600,775	15,922	4,748,385	56,991	4,188,111	40,767
Chimneys, globes, shades, etc. dut. No.	.....	94,463	.....	69,050	.....	267,642	.....	213,393
Articles and utensils for chemical, scientific, and experimental purposes dut.	.....	55,847	.....	46,198	.....	138,467	.....	120,041
Other glassware dut.	.....	145,504	.....	146,606	.....	364,433	.....	334,422